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AN ELECTRICAL FORECAST.

An address by Mr. Westinghouse on technical topics is always full of vital enthusiasm which is both suggestive and stimulating, and his paper before the Southern Commercial Congress at Atlanta recently is no exception to the rule. We fancy that no one will be disposed to deny his thesis that the application of power has been the great fundamental factor in bringing about the characteristic conditions of the era in which we live, nor will anyone hesitate in agreeing that the epoch in the dawn of which we now live is likely to be known as the age of electricity. The particular thing to which he directed the attention of his audience was the enormous possibilities for the South that lie in electric energy transmission with all that that implies of cheap distributed energy. The industrial possibilities of the South are just beginning to be realized. A purely agricultural territory for many years, it is just effectively awakening to a large and wonderfully promising industrial future, and in this energy transmission is to play a very large part. In fact, as many of our readers know, electrical energy transmission has already made a tremendous record in the South; the first electrically driven cotton mills were there located, and it must not be forgotten that the first electric railway of any importance was in Richmond.

There are several important networks intended for the complete distribution of energy over a very large territory, but the startling fact is that in spite of this activity the resources of the great southern Appalachian territory in the way of water power have as yet hardly been touched. Mr. Westinghouse states that the ultimate horse-power developable during the dry season in the Appalachian range is safely estimated at from 5,000,000 to 7,000,000, and incidentally he speaks a good word for the policy of conservation that is necessary to make the most of these natural resources. The Appalachian country is curious in one respect, that it has extremely few lakes, but it is not without natural facilities for storage in the deep mountain valleys, which can be utilized, fed, as such artificial reservoirs would be, by large drainage areas and heavy rainfall. Mr. Westinghouse's enthusiasm therefore is not overdrawn, and the opportunity of the South is a very great one. It is worth noting that even now the lowest prices for electrical energy which are found anywhere in our own country, and perhaps the lowest in the world, have been reached in some of the Southern plants. Many of the water powers have been comparatively easy to develop, and there is a large prospect for a vast increase in the available energy to be transmitted for industrial works of various kinds. Mr. Westinghouse does not exaggerate the possibilities of the South as an industrial region in the slightest degree. As a further study is made of industrial problems its prospects brighten. Mr. Westinghouse, for example, calls attention to the immense possibilities of the electric furnace in steel manufacture, utilizing as it can ores not so readily treated by other methods. With coal and iron in abundance and electric energy readily available the chance for large production is obvious.

Another interesting point brought out in the address under consideration was the bearing of the electrical situation on agriculture. Some portions of the South are specially favored in that they combine a very rich agricultural territory with large industrial resources. The agricultural possibilities can be greatly reinforced by the artificial production of fetilizers through the fixation of atmospheric nitrogen. Coal and lime in almost unlimited quantities, with cheap electric energy, make a formidable combination for carrying out such electrochemical operations, the more so since such works can be effectively carried on by utilizing surplus power so as to secure the advantages of large and steady load. Every cubic foot of water that runs over a dam is, from the dynamic standpoint, net waste; and beyond the limits of easy storage profitable utilization of the surplus is all-important. The suggestion, too, that transportation should be strengthened by electric roads operated from water power as feeders for the great trunk lines is a very important one. It is by no means new, since there have been many projects for such roads, some of which have been fortunately carried out. More of them have waited, to grow at even pace, we hope, with the industrial centers which will furnish them freight and passengers.

Turning from these more obvious things, Mr. Westinghouse looked forward toward some of the developments now in sight, but not yet realized on a commercial scale. Among these he recounts the wonderfully suggestive, though still inconclusive, work carried out under the direction of Sir Oliver Lodge a few years since on the stimulation of plant growth by electrical energy applied to the soil, and emphasizes the remarkable possibilities of the quartz lamp in the cheap and thorough sterilization of food products, to say nothing of purification of water. The additional suggestion that the same rays had been successfully applied to the artificial aging of wine will, we fear, be received with small enthusiasm by the advocates of prohibition. They might be better pleased if Mr. Westinghouse could suggest some method of rendering alcohol hopelessly unpalatable over large areas by the surreptitious use of potent and far-reaching radiations. It is particularly interesting to note that Mr. Westinghouse expresses strong faith in the very great possibilities of wireless telegraphy and telephony. These arts have been through so serious a period of stress in the last few years that there is something reassuring in this expression of abiding faith. Altogether this address of Mr. Westinghouse is worthy of careful reading and the South will certainly do well to heed some of the advice he has given.

CHEAPER CONSUMERS' METERS.

For several years past there has been an increased pressure put upon manufacturers to bring out less expensive meters for the smallest class of consumers. As central-station companies have developed the business possibilities in their fields more nearly to the saturation point they have found that the fixed investment per consumer in the case of small residences is so high that it constitutes the limiting factor in taking on this class of business. In other words, there are thousands of residences in our large cities and a proportionately great number in small towns the occupants of which could afford to pay for electricity for lighting purposes if only the necessary fixed expenses in the shape of a minimum bill or readiness-to-serve charges could be done away with. It is useless, of course, to expect to eliminate any large percentage of these fixed expenses, but every reduction helps. In looking for opportunities where a reduction can be made the first thing with which the central-station man is confronted is the high cost of meters per kilowatt connected in small-residence business. The cost of meters being the largest single item on the investment list, consequently it is the item which the central-station man will make the most effort to reduce, and hence the pressure brought to bear on manufacturers for cheaper meters.

Doubtless an added incentive for bringing such pressure to bear has been the feeling that the profits on consumers' meters have been higher than on similar goods sold in like quantities. Among arguments on this point current in the central-station field is the fact that meters are usually sold on a yearly contract basis whereby the selling expense is reduced to the work of getting the yearly contract. Added to this is the further fact that there is always a disinclination on the part of the central-station company to change types of meters on its lines, with the result that once a yearly contract is made and a considerable number of meters of a certain type are connected no more selling expense is involved in keeping a central-station company's meter business. Business of this kind, the central-station men feel, should be conducted on a narrow margin of profit, especially in view of the fact that the meter investment is so heavy for small consumers. It is the high meter investment plus the expense of maintaining central-station meters that has brought so many companies to consider and try out the plan of a flat rate with maximum demand limited by some cheap device. At any rate, the situation is one which the central-station man who is after the small-residence business is watching very closely.

VALUATION IN ST. LOUIS.

Between the values claimed by the Union Electric Light & Power Company and the Public Service Commission of St. Louis in the appraisal of the property of the company there is so wide a difference as to indicate at once that the cause of the discrepancy lies in the intangible elements. In the estimates of the "cost of construction and equipment," which included the larger items of the purely physical property, the difference was about 5½ per cent, or, in round figures, $700,000. The great discrepancy in the total values computed on behalf of the company and the commission may be indicated by a few figures. Two engineering estimates which the company advanced in its testimony placed values of respectively $30,888,000 and $30,780,000 as the total cost of the property and the business. Both of these estimates included some costs which were wholly disregarded by the commission in its computation. The commission computed the estimated cost of the present property at $16,590,000 and the earning value of the present property, after the deduction of depreciation, at $16,134,000. Each of the totals advanced varies materially from the outstanding capitalization of the company, which aggregates $25,544,000, divided between $15,559,000 bonds and $9,985,000 of stock. In some of the minor items of physical property there are differences which indicate that the tendency of all the values reached by the commission was lower than the figures determined by the company. For instance, in power plants and substations the commission's figures of cost of construction aggregated $7,424,000, or 4.8 per cent less than those of the company. The overhead system was figured by

the commission at $1,413,000, or 8.5 per cent less than the estimate of the company. The cost of the underground system, placed by the company at $3,013,000, was reduced 4.8 per cent by the commission.

Further light upon the extent of values other than the cost of construction and equipment may be had by reference to the estimates advanced by the corporation. Of the total cost fixed for the property and business, $4,408,000, or about 14 per cent of the whole, was stated as the cost of establishing the business; $2,637,000 and $2,407,000 were the two engineering estimates of the cost of financing. Of the total cost of reproduction of $24,000,000, the value remaining after deduction of these two items, the cost of construction and equipment amounted to $13,290,000, or about 55 per cent. Of course, a number of items in addition to the cost of construction are composed of tangible as well as of intangible elements. Interest during construction, although necessarily an assumed expense in the case of a property already built, is an expenditure that would become seriously tangible if an attempt were made to reproduce the property.

The valuation of the commission in this case is not the valuation of a State regulating authority, but of a local body which has jurisdiction only in the City of St. Louis. The commission is appointed by, and reports to, the Municipal Assembly, which is composed of two bodies. While the report includes a recommendation of the commission, based upon its valuation and investigation, for a new schedule of rates, the company is subject to reasonable regulation only directly by the Municipal Assembly, and any definite action that may be taken as a result of the valuation will be the decision of that body. In this respect the St. Louis commission is unlike the various State commissions which are given definite power by legislative act to order changes in rates. Whatever the result may be, the company has developed needed principles for the calculation of the costs of public-utility properties. Either for State or for other commission purposes or for the information of the officials of the company, valuations of all the elements of property should be undertaken by electrical corporations and every effort made to reach bases of computation that will protect the proper investment of security holders and assure reasonable conditions of service.

CHEMICAL ACTION IN THE WINDINGS OF HIGH-VOLTAGE MACHINES.

All known solid materials have a certain strength to resist longitudinal stress, and if this critical stress is exceeded they will break. Similarly, all known solid materials have a certain dielectric strength to withstand electric stress, and if this critical electric stress is exceeded they break down. Gaseous materials also come within the electric case. If air is overstressed electrically it breaks down. The break-down may or may not be accompanied by an arc discharge, according to the conditions governing the particular electrostatic circuit as a whole; but air which has been ruptured electrically is found to contain ozone. The theory is that an oxygen molecule consists of two oxygen atoms tied together. If the two constituent single atoms become torn asunder each is likely to attach itself to some neighboring oxygen molecule, to form a three-atom group, the so-called ozone molecule. An ozone molecule consists, then, of oxygen in a somewhat unstable triple atomic state, and very little persuasion will be needed to make the ozone molecule hand over the extra oxygen atom to a neighboring substance, leaving the two remaining oxygen atoms in stable equilibrium as a normal oxygen molecule. This lavish benevolence on the part of an ozone molecule, whereby it is so eager to give away an oxygen atom, on the principle that "two are company but three are a crowd," makes ozone so excellent and active an oxidizing agent.

An article by Messrs. A. P. M. Fleming and R. Johnson, referred to in this week's Digest, and recently published in *Engineering*, discusses the chemical action which is sometimes found to occur in the windings of high-voltage machines. It happens occasionally that a high-voltage generator will develop a short-circuit between adjacent turns in a slot. On opening the slot the insulating material is found to be chemically decomposed, the cotton rotted away, hard varnishes made soft and sticky and the copper conductors superficially corroded. The authors trace the action to air contained in pockets, or air spaces, within the slot. The air must first be subjected to a sufficient electric stress to effect its break-down. The ozone formed then presumably acts as an oxidizer on the insulating materials in the vicinity. These materials are ordinarily strong enough to resist stable oxygen at ordinary working temperatures, but their resolution to resist oxygen breaks down in the presence of ozone. According to laboratory experiments the authors find that air hermetically sealed in occluded pockets does not do any marked chemical harm. It is to be supposed, then, that such occluded air soon exhausts its oxidizing power and perhaps becomes reduced to inert nitrogen. But if the pocket remains open to the atmosphere, whereby fresh air can soak in, the chemical destructive action goes on steadily.

The deduction from such experiments is not, of course, that blind air spaces may be tolerated in high-voltage windings. The deduction is that there should be no unfilled spaces in the slots of a high-voltage winding, but that if there should be any, they should not have free access to the outside air. One inference from the research is that the designer of high-voltage machinery has many properties of materials to become acquainted with. He should work his mechanical materials up to a good mechanical stress, leaving, however, a proper factor of safety for contingencies. He should also work the dielectric materials at a good electric stress, leaving a factor of safety for surges and long service. He should work his magnetic materials at a good magnetic stress, leaving a suitable extra range for contingencies. He should also work all his parts at a good thermal intensity, so as to carry off heat rapidly, with a suitable margin against overheat and overload. He should finally work all his conductors to a suitably high current density, leaving a proper margin for overload. Plainly, unless he works his various materials up to proper limits of mechanical, magnetic, dielectric, thermal and conducting stresses he will not be getting full output from his machines; whereas if he overstresses any the machine may fail. The demands upon the designer for both experimental knowledge and practical experience tend to become more numerous and exacting in every decade. The article finally discusses the methods of construction best suited for avoiding chemical deterioration. These relate partly to avoiding break-down electric stresses in the winding space, partly to eliminating air spaces and partly to preventing short-circuits, ever if chemical corrosion should be produced.

Plans of N. E. L. A. Hotel Committee.

The N. E. L. A. hotel committee, through its chairman, Mr. Frank W. Smith, of the United Electric Light & Power Company, of New York City, announces the practical completion of the routine as to the arrangements for hotel reservations for the convention in New York, May 29 to June 3. Each member of the association will receive in due time a carefully compiled schedule of hotel accommodations and rates available for the members in attendance at the convention. The general convention headquarters will be in the Engineering Societies Building, 25-29 West Thirty-ninth Street, New York, where the business sessions and meetings of the association will be held and where the association offices are located. Therefore, no individual hotel has been designated as headquarters.

The schedule to be issued will take the form of an attractive circular with a complete and comprehensive map of the City of New York, showing transit facilities, subway and other stations and their relation to the Engineering Societies Building. A return post card addressed to the hotel committee will accompany this schedule, on which request for reservations may be made. As soon as the required accommodation has been secured the member will be notified by means of a reservation card which will have on it the member's name, address and accommodations held for him. This card, which will be numbered serially, is to be retained by the member and presented at the hotel desk when registering.

The hotel committee has also arranged for taxicab service during the week of the convention. A uniformed agent of the taxicab company will be in attendance at the Engineering Societies Building. Those desiring to arrange for reservations or those wishing to obtain information in advance of the mailing of the general announcement may communicate with Mr. Smith at 1170 Broadway, New York City.

Westinghouse on Federal Incorporation.

In an address delivered last week at Atlanta, Ga., on "Electricity in the Development of the South," Mr. George Westinghouse discussed the subject of federal incorporation, introducing his remarks with the statement that he had long held that a federal incorporation act, which the President advocates, under which all companies doing an interstate business could organize, would be a solution of the difficulties which are now almost insurmountable, and which are being added to in an alarming manner in the endeavor of the Legislatures of the several States to curb a few of the tens of thousands of companies and firms doing an interstate business.

After having read and carefully studied the bill providing for federal incorporation which was introduced in the long session of the present Congress he felt, however, that he would prefer to see a federal law in terms more easily comprehended by business men and devoid of those provisions which would give to a privileged few a practical control of a corporation by expedients which have been skilfully developed and which are now looked upon as a matter of course. He referred particularly to the depriving of minority owners of possible representation by the formation of voting trusts and the election of directors in classes, methods which can, and often do, defeat the purposes of laws which have provided for cumulative voting, whereby a substantial minority can insure the election of at least one member of a board of directors.

In his opinion, each director of a corporation should be required actually to own a substantial interest in the shares of the company the affairs of which he aids to control, and the term of office be only from year to year. To make the meaning clearer, he illustrated by supposing that a company had, by appropriate by-laws, established a board of five directors, only one of whom could be elected each year. Obviously, the provision of the law for cumulative voting would have no meaning in the government of the affairs of such a company.

Mr. Westinghouse stated that it may be unorthodox to say this, but it is his conviction that the conduct of a business without profit is disadvantageous to the community at large because of its demoralizing effect on the industry and its influence upon others. A federal incorporation act should provide for a statement, on prescribed forms, of the assets and liabilities of each corporation taking advantage of its provisions. This statement should be available to all who are asked to extend credit to the corporation. The disadvantage to a company of doing business at a loss under such conditions need not be enlarged upon.

In conclusion he said that each of the great corporations of to-day had its origin in a business established by an individual or small company based upon the skill and efforts of one or more individuals. The development of the South must be more or less rapid according as the work of such men is appreciated and encouraged, especially during the period of strenuous effort necessary to the building up of large and prosperous industries from small beginnings.

German Bureau for the Extension of Use of Electricity.

About eighty representatives of the electrical industries in Germany, manufacturers as well as central-station men, met in Berlin on Jan. 28 and organized a Bureau for the Utilization of Electricity. The main object of the bureau will be to promote the use of electricity in all its applications. Berlin

Einar Wikander.

has been made the headquarters of the new society and Mr. Einar Wikander, formerly a director of the Auer company and a well-known central-station expert, has been chosen for manager. The address of the society is: Geschäftsstelle für Elektricitäts Verwertung, Potsdamer Str., 68, Berlin W. 57.

The Institute of Operating Engineers.

The Institute of Operating Engineers, with headquarters in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, which was started with a temporary organization on March 17 of last year, has now 234 charter members, with some eighteen or twenty branches already formed or in process of formation. Among the objects of the institute are to unite in an organization those directly interested in operating engineering, the body also to serve as an educational institution for promoting acquisition of the skill, knowledge and personal qualities that render the operating engineer and the machinery operator efficient in their duties; to further a spirit of practical co-operation among the various grades of plant workers and between them and plant owners, as well as others interested, such as manufacturers, designing and consulting engineers, etc.; to establish in engineering and business colleges scholarships for successful student journeymen; to advocate and adopt a uniform apprenticeship system, that men may be systematically educated and trained as efficient journeymen machinery operators and operating engineers; to award apprenticeship and operating-engineer diplomas; to formulate standards and recommend to members and apprentices means for acquiring practical skill and technical knowledge. Among the

means for carrying out these objects will be the selection and registration of young men as apprentices, urging the introduction in public-school courses of general industrial training by competent men to all boys over twelve years of age; encouraging systematic preparatory courses either for home or evening instruction; arranging with local technical schools or colleges for the adoption of technical evening courses in operating engineering, leading to class certificates; establishing relations between the school, shop and power plant in order that men may have an opportunity of serving a regular period as student apprentices under qualified journeymen and operating engineers and thus receive simultaneous and systematic vocational training in the practice as well as in the theory and principles of operating engineering. Many other means to the ends in view are given in detail in the proposed constitution.

The membership consists of honorary members, associates, members, junior members, journeymen and apprentices. The honorary members are limited to twelve; the associates consist of individuals, firms and corporations operating power plants, machinery manufacturers, consulting and other engineers, instructors, lecturers, etc.; members are confined to master operating engineers who have a creditable record extending over fourteen years; junior members, known as operating engineers, shall have had not less than nine years of acceptable practical experience. The institute will grant certificates to the various classes of qualified members, maintain an employment bureau, hold meetings for the reading and discussion of papers, arrange visits to industrial plants, etc.

Columbia University has adopted the institute work in its extension course at the Teachers' College and it is expected that similar arrangements will be made with other colleges. The Williamson Free School has entered into an arrangement whereby its graduates will receive from the institute the certificate of journeyman. The secretary of the institute is Mr. M. W. Rice.

Prizes for an Experimental Study on Grounding and for a High-Tension Line-Disconnecting Device.

Marchese di Cambiano, president of the international prize competition committee of the International Exposition of Industry and Labor, to be held in Turin, Italy, this year, has notified the American Museum of Safety that the Italian Minister of Agriculture, Industry and Commerce and the National Board of Workmen's Insurance of Italy have offered a prize of $2,000 for the best experimental study on making earth grounds for electrical circuits and apparatus. The study must deal especially with the phenomena occurring when any point of an electric circuit comes in contact with the ground; with the influence of the composition and nature of the soil at which connection is made; with the influence of the form of the currents and their voltage; with the protective efficiency of earth grounding, either permanently or temporarily or in case of abnormal voltage, and with means for maintaining and testing grounds. The paper, which may be written in Italian, French, English or German, should also consider both the cases of normal régime and of disturbances from internal and external causes, and should include sufficient experimental data to support the treatment of the subject.

Another prize, of $1,600, is offered for a device by which an electric current at high potential may be cut out upon the breaking of a conductor. The apparatus should be such as can be mounted at any generating station or substation without requiring any important alteration in the installation of overhead wires or disturbing in any way the working of the plant. The competition for the above prizes closes on Sept. 30.

A number of other prizes are offered under the same auspices, as follows: A prize of $1,000 for the best device for shifting a belt, competition to close on April 30; a prize of $1,000 for a portable apparatus for moving pulleys with different diameters and mounted on shafts of different diameters, competition to close April 30; a prize of $500 for means to prevent accidents in rolling metals of any kind, competition to close April 30; a prize of $2,500 for devices lessening the danger of infection to which tannery employees are subjected in working with hides, competition to close Sept. 30. The American Museum of Safety, 29 West Thirty-ninth Street, New York, may be addressed concerning further details of the conditions of the prizes.

Electrical Shops in Europe.

By Captain Godfrey L. Carden, U.S.R.C.S.*

The European electrical works are large users of American machine tools. The installation at the Brown, Boveri & Company shops is tantamount almost to an exhibition of high-grade American machines. The same statement might be made of other electrical plants abroad, but the Baden shops are especially conspicuous in the use of the best grades of American tools.

In the Nonnendamm shops of the Siemens & Halske-Siemens-Schuckert Works there is at present turned out a very high class of electrical equipment, and the tools employed are nearly all of American or German origin. In the tool-hardening department at the Wernerwerke branch of this company the only ones in use are those of the American Gas Furnace Company, of Elizabeth, N. J. The opinion is held at Wernerwerke that the American-made gas furnaces are superior to any made in Germany.

The Siemens & Halske-Siemens-Schuckert Works employ about 13,000 people in all in the various shops located in Nonnendamm, and of this number fully 6000 are carried on the rolls of the branch plant known as Wernerwerke. All told Siemens & Halske-Siemens-Schuckert give employment to approximately 25,000 men and women.

The French Thomson-Houston Works were at the time of the writer's visit engaged in the manufacture of material both for the State and for commercial purposes. A large part of the government telephonic apparatus is handled by this firm, and in addition all kinds of electrical equipment are handled. The Curtis turbine is manufactured in France by the Thomson-Houston Company, its principal competition being with the makers of the Rateau, Parsons and Zoelly turbines. In the building of the Curtis the Thomas-Houston people have had recourse to Leflaire & Company. This latter firm is located in St. Étienne. It is understood that Leflaire & Company are looked to to produce the castings and machine all parts, leaving to the Thomson-Houston Company the supply of the electrical equipment. The Curtis turbo-generator sets are manufactured at Lesquin, near Lille, in the north of France. This plant was equipped especially for the manufacture of these Curtis turbo-generators and all large electrical units. The manufacture of small dynamos and motors is undertaken at another branch shop located at Neuilly-sur-Marne. The work here is for both direct current and alternating current up to about 30 hp. The Paris shops employ generally under 1000 persons, more often 750, this force being regulated by the state of the trade. At Neuilly about 200 persons are carried on the rolls, and at Lesquin about 100.

The Thomson-Houston Company is understood to have a working agreement which withdraws the General Electric and the Allgemeine Electricitäts Gesellschaft from competition on French territory. At the same time all new designs, plans and developments are exchanged freely between the three firms mentioned. The arrangement leaves only the French Westinghouse as an active competitor.

The Thomson-Houston was using malleable-iron gear covers for tram cars which had been ordered from a Buffalo (N. Y.) firm, but it was to substitute aluminum. The latter metal is, of course, more expensive, but the aluminum of a broken

*Captain Carden served during a period of eighteen months abroad as special agent for the Department of Commerce and Labor, and during that time visited many of the important plants in Europe. His reports are on file in the Bureau of Manufactures, Washington, and those which appeared in the *Daily Consular and Trade Reports* have been reissued in pamphlet form.

gear box can be sold, it was pointed out, for at least 50 per cent of its original value.

The Swiss electrical works have long held claim to high excellence. Zurich is the center of industrial Switzerland, and close by are the Oerlikon Electrical Works and Brown, Boveri & Company. The latter firm is located at Baden, about forty-five minutes run by train out from Zurich.

To understand properly industrial Switzerland it must be borne in mind that the country produces no coal and no iron ore. For the manufacture of machinery raw material is brought in for the most part from Germany, and the traffic is largely by river as far as Mannheim, and thence by train into Switzerland. In the winter season, when river navigation is not always possible, the transportation cost often advances from 25 per cent to 30 per cent.

While Switzerland is lacking in ore and coal the country can boast of an enormous amount of water-power, and in the development of the power the Swiss have gained world-wide renown. The firm of Escher, Wyss & Company, of Zurich, may be regarded as one of the first houses of Europe in water-turbine building. It was this house that was called upon for designs for some of the original water turbines for Niagara Falls, and it was from these same shops that turbine shipments were made direct from Zurich for installations on the Canadian side of Niagara Falls.

Hand in hand with water-turbine development one finds practically the superlative in electrical engineering, and to-day Swiss machinery is being sent to all parts of the world—that is to say, other than America. For much of their technical skill the Swiss have to thank their engineering institutions. They can lay claim to much practical experience and were among the first to participate in long-distance transmission.

The opinion prevails at Oerlikon that it will not be long before the single-phase system will be found in operation on a majority of the Swiss State railways. The Brown, Boveri & Company house, however, leans to the three-phase alternating current for railway work, and it is the opinion of the Baden firm that the advantage of the three-phase system is its exceptionally long life when applied to traction material. This, it is said, is a consequence of the simple construction of three-phase motors. To those acquainted with direct-current traction work and who know how often motors have to be repaired the importance of this feature will be appreciated.

At the Paderno central station, installed as far back as 1898, Brown, Boveri & Company demonstrated that it was practicable to switch out a fully-loaded 2200-hp generator under the very high-tension of 15,000 volts in a safe and reliable manner. This firm now builds single-pole high-tension oil switches which are capable of cutting out a total power of 75,000 kw at 60,000 volts if required.

Brown, Boveri & Company undertook, it is understood, the electrifying of the Simplon Railroad at their own expense, that is, the tunnel portion, and it was not until after the success of the work was demonstrated that the equipment was taken over by the Federal Railways of Switzerland. The Baden firm was among the first to succeed in adapting the polyphase motor in a practical manner to traction work, and in addition the motors of this firm are very much in use in Europe for such work as driving cranes, turntables, rolling-pins, pumps, locomotives and other machines.

Brown, Boveri & Company have taken up the building of blast-furnace blowers and of high-pressure compressors—the latter up to 100 lb. per square inch. One of these Brown, Boveri & Company blowers affords 16,000 cu. ft. of free air per minute, delivered against a terminal blast pressure of 7 lb. per square inch gage. The set runs at 3200 r.p.m. Just now Brown, Boveri & Company are making a specialty of electrifying textile plants, particularly for driving ring frames, and there has been developed a special type of motor of the single-phase repulsion type which permits of speed regulation in the simplest manner by merely shifting the brushes, and which results, it is understood, in affording an increased output of the ring frame and better quality of yarn.

When the Geneva water-works power station was installed by Brown, Boveri & Company the motor assigned was reported as the largest polyphase induction motor in existence. This is a 1000-hp, 5000-volt, two-phase motor direct-coupled to a centrifugal pump, which it drives at a speed of 455 r.p.m. The Baden people have designed a special type of generator, with vertical shafts for direct-coupling to turbines, and in the Olten-Aarburg central station is one of these vertical-shaft hydroelectric sets running at a speed of only 28 r.p.m.

The shop efficiency at Brown, Boveri & Company is very high, and the machine-tool department management is what one is accustomed to see, to a very large extent, in America. The superintendent of the machine-tool installation worked for some time in the shops of Pratt & Whitney, Hartford, Conn. Among the American machine tools in service were machines from the following houses: Brown & Sharpe, Ingersoll Milling Machine Company, Cincinnati Milling Machine Company, Norton Grinding Company, G. A. Gray Company, Whitcomb Machine Tool Company, Mark Flather Planer Company, Warner & Sevasey, Hendey Machine Tool Company, Putnam Machine Tool Company, Baker Brothers, Baush Machine Tool Company, Gisholt, Lodge & Shipley and "Acme."

Brown, Boveri & Company write off yearly many of their machine tools, and the practice is followed of selling the discarded tools to the small shops. While American chucks are bought the firm undertakes to make its own taps and dies, twist drills and gages, and it is understood that the firm is able to save fully 100 per cent through making its own taps and dies.

At the Oerlikon Works many American machine tools are in service, and here, too, the installation is a remarkably fine one.

The Oerlikon shops are working about 2000 people.

The American machine-tool firms represented on the Oerlikon floors include the following houses: Jones & Lamson, Brown & Sharpe, Potter & Johnston, Prentiss Brothers Company, F. E. Reed Company, Pratt & Whitney, G. A. Gray Company, Niles Tool Works, E. W. Bliss Company, Colborn, Landis Tool Company, Lodge & Shipley, Cincinnati Milling Machine Company, W. F. & J. Barnes Company, Gisholt, National-Acme, Cleveland Automatic Machine Company and Dresses Machine Tool Company.

One of the directors at Oerlikon remarked that the Lodge & Shipley engine lathes were regarded at that plant as superior to any foreign lathe, and it was their experience that this type of American lathe yielded a saving of 30 per cent in cost of production over any European-made lathe, barring only Darling & Sellers (English) make. The Darling & Sellers lathe, the writer later learned, sells for $145.80 more than the Lodge & Shipley of the same size.

In view of the high opinion entertained on the Continent of Darling & Sellers lathes the writer made it a point to visit that plant. It is a small establishment located in Keighley, England, having a very limited output, but doing really fine work. A full report (with the permission of Messrs Darling & Sellers) was made of this machine and can be secured through the Bureau of Manufactures at Washington.

There is hardly any line of electrical equipment that is not handled by the Oerlikon shops, and this statement applies especially with reference to power and traction apparatus. Special gear turned out embraces electric pumping and rolling mill installations, winding gears and electric locomotives, and electrically driven overhead traveling and revolving cranes. The last mentioned work constitutes one of the most important in Oerlikon's list.

Oerlikon is building turbines after the Rateau patents. Brown, Boveri & Company handle the Parsons, and Escher, Wyss & Company control the Zoelly. The last named originated with Escher, Wyss & Company and is the design of Director Zoelly of that firm. While at the Escher, Wyss & Company shops there was observed the 20,000-hp Zoelly turbine for the German scout cruiser *Cöln*. The advent of Escher, Wyss & Company in the list of steam-turbine builders is in itself an interesting fact, inasmuch as this firm has in the past confined its attention largely to water turbines. The Zoelly

turbines are being built for both land and marine purposes.

Good machinists at the Oerlikon Works earn between 96 cents and $1.35 per day, but the tendency is toward higher wages. The living cost of workmen in Zurich in proportion to the cost of living in America is roughly in the proportion of 1 to 2½ or 3. In general terms the cost of production in European shops exceeds the cost in the United States. This statement is not made with direct reference to electric plants, but to machinery-producing works as a whole. As is well known, the practice in many American machine-tool establishments and other works is to keep a record of the production per man per year, basing the same on a record of all material produced within a given twelve months, taking the value at the net price received by the manufacturer and dividing this sum by the total working force, exclusive of the office help. Resulting figures of $1,850 per man, and higher, are not unusual in American shops. At a well-known plant in Prague, one of the best of its kind in Europe, the corresponding figure was 1784 crowns ($362). The highest earning rate found at any European shop visited was $1,186 per man per year.

Electricity in the Development of the South.

In an address before the Southern Commercial Congress, Atlanta, Ga., Mr. George Westinghouse outlined the part being played by electricity in the development of the South. He remarked that the coming epoch, the dawn of which is now here, will be known as the "Age of Electricity." This condition he attributed to the development of the alternating-current system, which overcame certain limitations in the direct-current system. The latter was first introduced and its advocates bitterly opposed the introduction of alternating-current apparatus because of its alleged danger to life.

In view of the fact that the rivers of the Appalachian Mountains can be developed for from 5,000,000 hp to 7,000,000 hp during the dry season of the year it can be seen that hydroelectric installations are destined to assume a universal and fundamental part in the life of future generations in the South. A noteworthy beginning has been made by the Southern Power Company, which furnishes energy for lighting forty-five cities and towns and for operating six street-railway systems.

Mr. Westinghouse expressed the opinion that the industries most likely to be developed and to increase because of peculiar suitability to conditions now existing in the South are textile mills, fertilizer works, cement plants, coal, iron, copper and gold mining, ore-reduction plants, iron and steel mills, agricultural implement works, canning factories, road building, furniture manufacture, lumber plants, paper mills, shoe and leather factories and oil refineries, in all of which industries electric power service increases the production.

Equal in importance to the development of the water-power resources are the existing restrictions which make it difficult and expensive for a small corporation to carry on conveniently and in a simple manner its business with ramifications in several states. Mr. Westinghouse expressed his desire for a federal incorporation act under which all companies doing interstate business could organize in order to overcome the difficulties which are now almost insurmountable and which are being added to in an alarming manner by the separate Legislatures of the several states.

Cost of Industrial Motor Service.

At the joint meeting of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers held in the Engineering Societies Building, New York, on March 10 three papers dealing with the general subject of the cost of industrial motor service were presented and discussed. Two of the papers were by Mr. John C. Parker, mechanical and electrical engineer of the Rochester Railway & Light Company, and one by Mr. Aldis E. Hibner, industrial engineer of the Toronto Electric Light Company.

In a paper entitled "Comments on Fixed Costs in Industrial Power Plants," Mr. Parker discussed in detail the various costs of industrial motor service which are not closely a function of the energy output. These costs include the interest on the investment, taxes, insurance, depreciation, obsolescence, supervision, fair profit and rental of building space. He called particular attention to the so-called marginal principle as being of critical importance. He showed that it is not always advantageous to increase the equipment of, say, a hydroelectric plant even when the cost of the final installation is within the value assigned for the permissible cost per unit of equipment rating. This condition is attributable to the fact that the "marginal unit" last added to make up the total is much more costly than the average, and hence than the permissible, cost, and therefore it could advantageously be omitted. He contended that the point at which to stop development is that where the marginal investment produces a marginal profit of not less than the fair profit which will satisfy the financiers.

In his second paper Mr. Parker showed that the various elements entering in the total cost of the energy output from a generating station during any stated period can be expressed in the form of an equation containing three terms, one being a certain constant, the second another constant multiplied by the rating of the station and the third a different constant multiplied by the kw-hours generated during this period. He discussed each element of cost separately and stated in which terms of the equation the element should appear.

Mr. Hibner gave an outline of the different factors to be considered in the cost of industrial motor service, discussing particularly the relative economies of generating the required energy locally or purchasing it from a central station. He said that the three general factors entering into the problem are the investment charges, the operating charges, the cost of heating or use of low-pressure steam. He gave estimates of the cost of a certain 100-kw combined steam-heating and electric generating plant and showed that the actual cost per kw-hour was 2.5 times as great as the owner had supposed. This discrepancy is attributable to the fact that this owner, as is true of most manufacturers, did not know the load-factor on his factory, while the load-factor is one of the most important elements in the cost of industrial motor service.

Discussion.

Mr. N. T. Wilcox called attention to the fact that few people know the cost paid by them for each hp-year in industrial service, and cited two cases where the actual costs were from 50 per cent to 100 per cent higher than the supposed costs.

Mr. P. R. Moses claimed that Mr. Parker had exaggerated each item in the cost of isolated-plant service and gave figures to modify the values specified by Mr. Parker.

Mr. D. B. Rushmore remarked that reliability is one of the most important factors in industrial motor service. With most hydroelectric installations it is necessary to provide steam relays for use in case of interruption. In recent years conditions have so improved that at present a steam turbo-generator can be started from rest and placed under load in about one-half a minute.

Mr. R. P. Bolton remarked that the demands for exhaust steam for heating and electricity for industrial service do not coincide as to time, and this fact greatly complicates the problem of determining the advantage or disadvantage of substituting central-station for isolated-plant service.

Mr. H. W. Peck called attention to the fact that the lack of simultaneous demand for exhaust steam heating and load on the engines for industrial purposes may easily result in a coal consumption from 50 per cent to 75 per cent in excess of the amount that would be required if the two demands occurred simultaneously.

Mr. John H. Norris presented estimates made on a number of gas-engine-driven electric generating stations tending to show low cost of service. The costs ranged from 0.7 cent to 3.8 cents per kw-hour, the former being for a 200-kw equipment and the latter for a 15-kw equipment.

Mr. Stonewall Tompkins gave an analysis of the equipment and operating costs of delivering energy at the Coney Island Railway substation and showed the total to be 0.77 cent per kw-hour.

Mr. Arthur Williams called attention to the fact that a certain investigation has shown that the coal actually consumed by isolated plants in three apartment houses, three hotels and three clubs in New York averaged 17.3 lb. per kw-hour, the maximum reaching 25 lb. In spite of this showing the coal consumption is customarily put at from 6 lb. to 7 lb. in preliminary estimates.

Mr. Parker H. Kemble remarked that 10 lb. of coal per kw-hour is a fair estimate for a 100-kw plant.

Mr. H. H. Edgerton showed that the cost of service from an isolated plant is greater than 3 cents per kw-hour when only interest and depreciation are considered, so that all production and distribution costs would be saved by purchasing energy at this rate from a central station.

Mr. C. M. Ripley stated that the Commonwealth Edison Company of Chicago owns and operates at least three isolated plants in the basements of buildings and argued that the owners could depend on such plants if the central station finds it advantageous to do so.

Mr. George L. Fowler said that isolated plants are run by methods that will not bear analysis and the costs are so erratic that they cannot be predetermined.

In reply to the criticisms of Mr. Moses, Mr. Parker showed that the estimates made by him were not theoretical, but were taken from an actual case within his own experience.

A. I. E. E. Papers on Transformer Problems.

One of the prominent features of the mid-year convention of the American Institute of Electrical Engineers, held on Feb. 14, 15 and 16, was a trip from Schenectady, N. Y., to Pittsfield, Mass., where the transformer factory of the General Electric Company was inspected and four papers relating specifically to transformer problems were presented and discussed. The authors of these papers were Messrs. F. C. Green, C. E. Allen, J. M. Weed, and J. J. Frank and H. O. Stephens. A paper by Dr. C. P. Steinmetz entitled "Mechanical Forces in Magnetic Fields," which contained many data of value to transformer designers, was also read and discussed. Abstracts of these papers and discussions are given below.

In the paper by Mr. Green many interesting problems encountered in the operation of transformers were discussed in detail. The author stated that abnormal voltage conditions are responsible for almost all transformer failures. The total abnormal voltage impressed is not in itself dangerous; the damage is caused by the disturbance of the voltage equilibrium within the windings. This fact is shown by the small percentage of punctures between the coils and core as compared with the punctures between turns of the same winding. The present small percentage of transformer failures can be reduced to an inappreciable value by increasing the effective insulation between parts of the winding most liable to damage.

Although formerly it was considered desirable to build transformers with minimum voltage regulation, it is now appreciated that low impedance means high short-circuit current and enormous stresses under short-circuit conditions. The troubles arising from this cause have been cured by inserting separate reactance in circuit with transformers having low inherent reactance, by designing for higher inherent reactance and by increasing the surfaces of coil-supporting strips.

The author showed that it is a mistake to assume that a so-called self-cooling transformer will operate at a satisfactorily low temperature regardless of the surroundings that do not admit of the free escape of the heat. So far as the production of heat is concerned a transformer is similar in every respect to the furnace of a boiler and adequate circulation of air around the transformer is necessary to insure low temperature during operation.

The author described in detail numerous combinations of transformer connections in polyphase systems that may cause trouble either immediately upon being placed in service or subsequently under peculiar conditions.

In his paper on regulation Mr. Allen called attention to the discrepancies in the results obtained with the various methods used in calculating the voltage regulation of transformers. He assumed the case of a transformer having a resistance drop of 1.5 per cent, a reactance drop of 2 per cent and a magnetizing current equal to 5 per cent and showed that the calculated regulation at unity power-factor load would vary from 1.50 per cent to 1.62 per cent according to the method selected. and at 50 per cent power-factor would vary from 2.48 per cent to 2.58 per cent. Much of the difference in the calculated regulation is attributable to the neglect of the effect of the exciting current, which was of no importance in the older transformers, but is of some importance in the modern silicon steel transformers. However, since the exciting current exists at both no-load and full-load it has relatively little effect upon the regulation expressed as the ratio of the rise of secondary terminal voltage from rated full-load to no-load, to the secondary terminal voltage at rated load.

The paper by Mr. Weed was devoted to a detailed analysis of the temperature gradient in oil-immersed transformers. The author mentioned the unsatisfactory results obtained in certain instances when the temperature rise in a transformer is based on an analysis of only the watts per square inch at the surface of the transformer and the surface of the tank. The rules based upon this analysis are not always safe when applied to new types of transformers.

The paper contained a discussion of the fall of temperature as the internally generated energy passes from the hottest part of the coil to its surface, within the insulating covering, if the coil is covered; through the insulating covering on the surface of the coil to its outside surface; from the surface of the solid insulating covering, or coil, into the adjacent oil; through the oil from a point adjacent to the coil, to a point adjacent to the tank for a self-cooling transformer, or to a point adjacent to the cooling coil for a water-cooled transformer; from the oil to the metal of the tank or the cooling coil; through the walls of the tank or the cooling coil; from the external surface of the tank to the surrounding air, or from the inner surface of the cooling coil into the water.

Distinct consideration was given to radiation, conduction and convection. As compared with perfect radiation having a value of 3.425, lampblack radiates 3.29, terne plate 0.535, rusted iron 2.75, new cast iron 2,61, polished sheet iron 0.189, ordinary sheet iron 2.275. With a rise of 40 deg. C. the total heat discharged by both radiation and convection from an ordinary boiler tank with plain surface is ordinarily about 0.25 watt per square inch. Of this total about 60 per cent is lost by radiation. Since radiation is not increased by corrugation except in so far as the external dimensions of the tank are increased the increased cooling with a corrugated tank is due mainly to the increase in convected heat. Hence a corrugated surface is very ineffective as compared with a plain one of the same developed area. Comparing a plain tank with a corrugated one of equal dimensions, but with four times the developed surface, if all parts of the corrugated surface are equally effective for convection with the plain surface, and if 40 per cent of the heat thrown out from the plain tank is convection and 60 per cent radiation, the total heat thrown out by the corrugated tank will be 40 per cent $\times 4 +$ 60 per cent $=$ 220 per cent of that thrown out by the plain one, so that the watts per square inch thrown out by the corrugated tank, at the given temperature, are $220 \div 4 = 55$ per cent of the watts per square inch from the plain one, and the radiation from the corrugated tank is $60 \div 2.2 = 27.3$ per cent of the total heat thrown out.

The relative merits of the most commonly used designs for self-cooled transformers, and oil-filled transformer tanks were presented in the paper by Messrs. J. J. Frank and H. O. Stephens. Mention was made of a recent development along the line of corrugated surface consisting of a tank with com-

pound corrugations. It is obtained by double-corrugating the surface so that it will be made up of major and minor corrugations. When the circulation of the oil within a tank is confined to a definite path down along the cooling surface of the tank local eddy currents in the oil are avoided and the circulation is much more effective.

Reports were given of tests made on tanks of plain cast iron, plain boiler plate, corrugated cast iron with 4.2-in. pitch and corrugated steel with 3.2-in. pitch. At 0.20 watt per square inch of radiating surface the temperature rises were 29 deg. C., 31 deg. C., 35 deg. C. and 45 deg. C. respectively. Tests were also reported to show that of two tanks otherwise similar one having 88 per cent greater radiating surface radiated only 19.6 per cent more losses at an equal temperature of 40 deg. C.

The nature of the radiating surface has considerable effect upon its radiating properties. In addition to the material itself the color and character of the paint has some effect upon the radiation of tanks, especially when they are exposed to the direct rays of the sun. Tests indicate that tanks painted with white enamel or aluminum paint run several degrees cooler in the daytime and slightly warmer at night than tanks painted with black paint.

One item of primary importance in designing transformer tanks is the cost. The following table gives average comparative costs of tanks designed to radiate from 1 kw to 3 kw loss at 40 deg. C. rise in the oil, plain cast-iron tanks being used as the standard of comparison:

Plain cast iron	100
Plain boiler plate	97
Corrugated cast iron	93
Corrugated steel	61

The above figures do not include the cost of oil, and if this were added the difference in cost between the plain and corrugated tanks would be greater. For larger losses a similar comparison would show an increased advantage in favor of the corrugated-steel tank and other more complicated surfaces, and if the losses are still further increased the plain tank becomes quite out of the question.

Dr. Steinmetz's paper dealt with the mechanical force produced upon a conductor carrying current when placed in a magnetic field. The treatment employed was based on a study of the energy stored in the magnetic field, the mechanical energy produced by motion in the magnetic field being equal to the difference between the electric energy consumed by the induced e.m.f. and the increase of the stored magnetic energy. The mechanical force is determined by dividing the mechanical energy by the distance traveled. Even where motion is not produced the force may be determined by assuming an infinitesimal movement and calculating the change in energy produced thereby.

The author applied the above method to the pull of constant-current electromagnet, the pull of constant-potential alternating-current electromagnet, the stresses in stationary transformers, and the repulsion between parallel conductors.

The author stated that the problem is not entirely determined by the two end positions of a plunger magnet, but the function by which the current and the inductance are related to each other must also be given.

Discussion.

In discussing Dr. Steinmetz's paper Dr. A. S. McAllister stated that the equations for determining the mechanical force in magnetic fields are directly applicable only when the coefficient of self-induction is constant. When this coefficient is not constant, the equations become so complicated that resort must ordinarily be had to graphical methods. In the case of a plunger magnet the change in energy when the plunger moves represents a change in energy of condition rather than energy of position, and hence is analogous to kinetic rather than to potential energy. The movement of the plunger is incidental to the change in energy, but the change in energies cannot be treated directly as due to the change in position.

Mr. G. Faccioli called attention to the fact that mechanical forces in transformers can most readily be reduced by increasing the reactance in the transformer circuit. This reactance can be either external or internal, but the reduction in the forces is greater when the reactance is external on account of the simultaneous reduction in the main magnetic field of the transformer.

Mr. J. M. Weed outlined a mathematical formula for expressing the forces between transformer coils and derived results identical with those of Dr. Steinmetz.

Mr. C. Davis described a graphical method for determining the change in magnetically stored energy in solenoids with the movement of the plunger. His treatment was based essentially on the product of the elements of two areas representing the current increasing with time and the induced e.m.f. decreasing with time.

Mr. W. Harper gave a physical analysis of the mechanical forces exerted on transformer coils, with special reference to the warping parts. He stated that the values of forces given by Dr. Steinmetz had been verified by numerous tests to within from 2 per cent to 7½ per cent, according to the mechanical arrangement of the conductors investigated.

Mr. F. C. Green described in detail the repelling forces existing between parallel flat coils in transformers.

Mr. J. Barrow showed that when the calculation of the mechanical forces between two parallel flat bars is based on the assumption of currents concentrated at the center of the bars the discrepancy between the calculated values and the observed values varies considerably with the distance between the bars. When the bars are relatively close together the discrepancy is quite large, but when they are separated by a considerable distance the calculated values agree quite accurately with the observed values.

Mr. A. H. Pikler explained the apparent increase in destructiveness of the mechanical forces in modern transformers as compared with the older transformers. This increase he attributed to the decrease in the reactance of modern transformers as compared with transformers of the earlier types, the current under short-circuit conditions being much greater in modern transformers than in transformers of the older type. He expressed the opinion that transformers are not constructed with proper regard for the mechanical forces produced during short-circuiting.

Mr. J. J. Frank stated that the increase in the destructive forces in modern transformers can be attributed largely to the greater concentration of power in modern electrical systems as compared with the older systems. That is to say, although transformers at the present time more frequently show results of distorting forces in the coils, this fact is not attributable solely to the change in the design of the transformers, but would be found in older transformers if used under modern conditions.

Mr. C. F. Scott stated that by far the best conception of the magnitude of the forces which transformers are called upon to withstand can be gained by examining some of the transformers destroyed by such forces. He cited a certain case where destruction had been produced by a short-circuit between the turns on one coil, which thereby made of itself a closed secondary carrying enormous current in its local circuit. Under such conditions destruction is almost sure to result.

Mr. W. S. Moody called attention to the great importance of the investigation of temperature gradient in oil-immersed transformers, as described by Mr. Weed. Investigations of this kind result in the elimination of the old "cut-and-try" methods by increasing the knowledge of the individual elements which are involved in the total temperature drop.

Mr. A. H. Pikler stated that of equal importance with the proper design of transformers is the proper installation of the units in the equipment with which they will be employed. He expressed the opinion that, although a temperature rise of 40 deg., as now specified for transformers, was proper with the older types, this limiting temperature is too low to be applied to modern transformers. In view of the improvements that had been made in core material and insulation it is per-

missible, and highly desirable, to increase the temperature limit to as much as 60 deg. C.

Mr. E. G. Reed mentioned the fact that the methods employed for causing a transformer to cool itself automatically have been so much improved in recent years that at the present time transformers provided with cases having pipes attached for causing the cooling are now being built for ratings as high as 3000 kva.

Mr. E. A. Wagner expressed the opinion that the formula for determining the regulation of transformers should be standardized in order to eliminate the confusion which exists at the present time. He said that there is a limit to the depths to be employed in corrugating tanks of transformers beyond which a further increase produces no appreciable increase in the cooling effect. It is preferable not to use corrugations having a depth greater than about twice the opening.

Prof. C. A. Adams showed by means of vector diagrams the conditions under which third harmonics can be produced or can be eliminated from a three-phase system. In a delta-connected system the exciting current has a triple-frequency component, while the voltage is sinusoidal. In a star-connected system the exciting current is sinusoidal, while the voltage to the neutral point contains a triple frequency, so that the neutral e.m.f. point rotates around the true geometrical vector point.

Mr. R. D. Mershon questioned the advisability of constructing transformer cases with the same amount of area exposed to the air as to the oil on account of the fact that oil can more readily transfer its heat to the case than can the case discharge its heat into the air.

Mr. C. W. Stone stated that at the present time there is less need for good voltage regulation than was true in former years, and hence it is not only not disadvantageous but is advantageous to allow the transformers to possess considerable reactance.

Mr. E. F. W. Alexanderson outlined the results of tests showing the cooling effect of air at different velocities. In a certain case cited it was found that when the velocity of the cooling air was specified in feet per minute the watts per square inch for a certain temperature rise had a value which could be represented by the quantity 1 plus one-thousandth part of the velocity. Thus, for example, the cooling effect of air moving at 1000 ft. per minute was just twice that of air at rest.

Mr. H. O. Stephens called attention to the fact that in any self-cooling transformer the temperature is much higher at the top than at the bottom, so that incorrect conclusions are drawn when one bases his conclusions on the assumption that the radiation is uniform throughout the height of the transformer.

Dr. C. P. Steinmetz stated that reactance is of greater advantage in short, low-impedance lines than in long, high-impedance lines. Series reactance not only does not tend to increase the wave distortion, but has the opposite effect of wiping out the higher harmonics, in view of the fact that the effective reactance increases directly with the frequency. A series reactance intended for protecting a transformer on short-circuit should be built without an iron core. When iron is used in the circuit it becomes saturated with an abnormal increase in the current and ceases to be effective at the very time when needed.

Report on St. Louis Rates and Valuation.

A summary giving the conclusions in the report of the St. Louis Public Service Commission on the Union Electric Light & Power Company was published in the issue of the *Electrical World* for March 9, 1911. As the valuation of the property was designed to furnish a basis for rate-making, additional extracts outlining the suggestions made by the commission and explaining its position are given herewith.

The commission states that the company co-operated in every way in the investigation, affording access to books and papers giving all information at the command of the company, presenting much testimony at the public hearings and also having prepared a complete financial history.

The accountants for the company in their first presentation of claims for value of the investment on which earnings should be computed presented tables, of which a summary is given in the report. The value of the total tangible property as of Dec. 31, 1908, was stated therein to be $23,411,867 and of the intangible property $4,104,428, making a final total before deductions for depreciation of $27,516,295.

TABLE I.—ESTIMATED COST OF REPRODUCTION NEW AS EXISTING OF THE PROPERTY OF THE UNION ELECTRIC LIGHT & POWER COMPANY AS OF OCT. 31, 1909, BY FORD, BACON & DAVIS.

	Item.	Total.
I. Development		
1. Development period (obtaining rights and capital).		
a. Time and expense of development organization (3 per cent of item II)	$724,365	
b. Interest on expenditures during development period (computed)	138,355	$862,720
II. Construction		
1. Time and expense of permanent organization (inventory price)		428,905
2. Cost of reproducing real estate (as per appraisal)		3,449,220
3. Cost of construction and equipment based partly on labor and material and partly on subcontracts.		
	Inventory Price.	
a. Building and improvements	$2,787,343	
b. Piping	335,825	
c. Power-plant equipment	3,365,535	
d. Substation equipment	661,757	
e. Switchboards	332,596	
f. Series arc apparatus	61,234	
g. Storage batteries	259,061	
h. Distribution system, underground	2,869,323	
i. Distribution system, overhead	1,471,624	
j. Transformers	182,534	
k. Meters	361,711	
l. Arc lamps	116,521	
m. Nernst lamps	45,163	
n. Motors	19,288	
o. Isolated plants	30,969	
p. Steam-heat lines	12,650	
q. Teams, wagons and automobiles	45,589	
r. Tools	32,724	
s. Furniture and fixtures	44,938	
t. Incidentals and contingencies (5 per cent of items 3h-3s)	253,308	$13,289,693
4. General contractor, overhead charges and profit (10 per cent of item 3)		1,328,969
5. Cost of engineering (5 per cent of items 3–4)		730,933
6. Interest on construction expenditures (computed)		2,490,749
7. Taxes and insurance on construction (computed)		276 365
8. Working capital		
a. Stores and supplies (actual per records)	$391,246	
b. Cash or equivalent (actual as per auditor)	484,578	
c. Incidentals (10 per cent of item 8a)	39,124	914,948
9. Edison licensee agreement (estimated)		200,000
10. Kinloch pole right agreement (estimated)		100,000
Total cost of reproduction as of Oct. 31, 1909 (subject to exceptions noted below)		$24,072,502

Note—The above estimate does not include any:
(a) "Going concern" value of the character recognized by authoritative decisions.
(b) Profits of promotion.
(c) Discounts and commissions on securities.
(d) Special value of existing franchises.
(e) Assets not included in estimated cost of reproduction.
(f) Net investment in superseded property.

In reaching these figures the accountants built up a figure of the cost of the property on the continuous-property theory. The results of the application of this theory are given in several tables which show the investment in the property, the income actually earned thereon, and the deficiency in return added to the investment, in accordance with the practice adopted by the Railroad Commission of Wisconsin in the Antigo Water Company case. The return was calculated in the various tables at the different rates of 6 per cent, 7 per cent, 8 per cent, 9 per cent and 10 per cent. These calculations are based upon assumptions of cost as selected from the records of predecessor companies and the present company, and upon the theory that

a public-service corporation is entitled to earn and distribute in interest and dividends from its beginning a certain percentage upon the investment above all charges, including a proper allowance for depreciation.

The conclusion of the commission is that the more study is given to this theory the less does it appear to be a safe or reasonable guide to a value upon which the company should be allowed to earn returns. The commission adds that the report was founded in part upon items taken from the books of extinct companies and that some of the items treated on the same basis as cash transactions are the result of stock and bond operations, in which the assigned value of the securities may or may not represent real values.

In rejecting these figures the commission states that it intends no reflection upon the sincerity of the accountants for the company or upon the company. It says that a great part of the items are undoubtedly correct, but the necessarily problematical basis of some of the items renders them unavailable for the present purpose. The commission believes that the period during which a deficit should be allowed to be capitalized as the cost of establishing a business should be limited to a reasonable time at the beginning of a new business, that it must also be assumed that there is a reasonable demand for a utility when built, and that the property was well managed during the period of deficit.

The theory of the cost of reproduction new as presented by the company means, the commission states, that the value upon which it should be permitted to earn a fair return should be the estimated cost of reproduction at the present time of the property as it now exists. This theory is rejected by the commission on the ground that it disregards the actual conditions under which the property was produced, and sets up a purely hypothetical case. A summary of the estimated cost of reproduction new as existing of the property of the company on Oct. 31, 1909,, based upon an appraisal made by Messrs. Ford, Bacon & Davis and presented by the company, shows a total value of $24,072,502, distributed as shown in Table I.

Some of the items correspond closely to the figures obtained by the commission, while others, the report says, appear unreasonable in amount and vary greatly from the corresponding figures of the commission. In discussing the methods followed in its appraisal of the physical property the commission states that its representatives, whenever possible, inspected and listed personally in detail each item of property, and the record of the buildings of the company was made from actual measurements and from plans and data. The equipment of each generating plant and substation was inspected and listed.

In making the inventory of the overhead system the commission had working maps prepared from the records of the company, showing the location of each individual pole and giving the size and length of each run of wire. These maps were checked by inspectors of the commission.

In making an inventory of the underground system of conduits and cables the commission separated the proportional ownerships as between the Union Electric Light & Power Company and the Phœnix Light, Heat & Power Company, and also assigned the costs of the city ducts in proper proportion to each of the present joint owners. In addition to the joint-conduit systems there are conduits owned wholly by the Union Electric Light & Power Company, and another system in which that company has an interest. Each system was inventoried separately. The cables were mapped, inventoried and inspected.

After the completion of the inventory of the entire physical property the engineers of the commission assigned to each item, as nearly as possible, its original cost in place and ready for service. When possible these costs were taken from actual signed contracts in the files of the company. Where such contracts did not exist cost estimates were made from data for similar work calculated by the engineering staff.

After the completion of the tentative valuation of the physical property an opportunity was given the company to go over the work in detail. The report says that the estimate of construction costs made by the company does not show any greater difference in results from that made by the commission than could be expected from two appraisals, both honestly made, but from slightly different points of view, and that the entire difference in estimated cost of the present existing valuation of the property is not great enough to affect materially any rates which might be based upon either estimate. The most difficult point of agreement is in certain items of labor.

The plant of the company includes three large generating stations with full equipment, seven substations and equipment, and a number of other buildings. In the overhead system there are approximately 13,000 poles with 24,000 cross-arms, besides 32,000 cross-arms owned by the company but located on other poles. The wire in the overhead equipment amounts to approximately 3800 miles. In the underground distribution equipment there are about 350 miles of cable of different sizes and approximately 700 miles of ducts of different types. Added to this are innumerable smaller items.

In determining the earning value of the property the commission states that its aim has been to arrive at a fair and reasonable present value of the property in the service of the public at the time of its investigation.

TABLE II.—PRESENT PROPERTY—ESTIMATED COST AND ESTIMATED EARNING VALUE, AS COMPUTED BY THE COMMISSION.

	Estimated Earning Value.	Estimated Cost.
I. Organization—		
1. Expense of organization	$125,500	$125,500
2. Interest on organization expense	32,944	32,944
II. Construction—		
1. Real estate	800,000	414,240
2. Cost of construction	12,586,741	12,586,741
3. Cost of engineering	629,337	629,337
4. Interest on construction expenditure	725,780	725,780
5. Taxes and insurance during construction	130,203	130,203
III. Working capital	865,520	865,520
IV. Kinloch pole contract	80,000	80,000
V. Allowance for cost of establishing business	1,000,000	1,000,000
	$16,976,025	$16,590,265
Deduct depreciation for present condition	841,632	
	$16,134,393	$16,590,265

Table II, published herewith, shows the estimated cost of the present property of the company as determined by the commission, before deduction is made for depreciation for present condition and before addition is made for present value of real estate, and also the estimated earning value.

While the commission holds that the company is entitled to have recognized as part of its assets some expenses of organization, it says that expenses preliminary to the organization of a corporation, in prospecting the field and interesting prospective stockholders, and promoters' profits are not under the laws of the State proper items for consideration.

In the determination of the value of the land it seemed necessary to the commission, in order to be consistent, to follow the same rule as in the case of the other property of the company and take the present value. All the land belonging to the company was held in fee except three pieces. In these cases the company holds ninety-nine-year leases, in which the expired portions are so short as not to affect the value.

There was a difference of 5.51 per cent in the respective estimates of the company and the commission of construction cost. The difference between the commission and company estimates of construction cost of the overhead system was 9.33 per cent, and of the underground system 5.005 per cent. For a general contractor's profit the company claimed 10 per cent. The commission took the position that, as a matter of fact, there was no general contractor's profit, and that in the creation of such plants as the one under consideration, as they are generally created, there is seldom such an expenditure. The commission and the company were agreed in adopting 5 per cent as the proper percentage for engineering costs.

There was a wide difference between the figures of the commission and of the company on the subject of interest on

construction expenditures. The commission holds that the item of interest and insurance during construction is entirely legitimate as an element of value and that the only question is as to the reasonableness of the amount claimed.

The commission could see no substantial pecuniary value in the contract with the General Electric Company. It held that if the Union company had a right to receive discounts from the General Electric Company it was not by reason of the Edison licensee contract, which seemed to the commission to do no more than to protect the licensee against discrimination in favor of other licensees of the General Electric Company.

Regarding the cost of establishing the business, the commission considers that that amount of the cost of establishing the business of the predecessor companies by which the present company and the present consumers are being benefited is a justly allowable element in the present earning value of the property. The commission held that the element of going value in valuation for rate-making purposes was identical with the cost of establishing the business.

The accountants for the company insisted that discount on bonds was properly chargeable to cost of construction, and the company asked that such discount, irrespective of the purpose for which the proceeds were used, be recognized by the commission as part of its capital invested. The commission does not see that any principle can be invoked which will justify the distinction suggested by the books of the company, nor does it believe that discount on bonds in any case should be treated as part of the capital invested. In its opinion the discount should be treated as interest, to be paid out of the fair rate of return allowed upon the earning value of the property. The commission has not taken into consideration any property on which the company is entitled to earn a return on franchise rights for the reason that, in its opinion, the company is not entitled to a return on such franchises. The commission does not consider that abandoned property enters into the calculation of a fair value of the property at present in the service of the public, except so far as it affects the cost of establishing the business.

Indiana Railroad Commission.

That when the new laws go into effect the Indiana Railroad Commission will have greater powers than any similar commission in the country is the belief of the members of the commission. With the exception of a bill to punish trespassers walking on railroad tracks, all of the measures championed by the commission become law. A new era in the work of the commission is predicted since the limitations that hampered it in its work heretofore have been removed. Within the field of its jurisdiction the Indiana commission will have power almost equal to that conferred upon the Interstate Commerce Commission.

The commission regards the new act giving it power to compel interurban companies to install one of the three recognized systems of block signals—the manual, the manual controlled, the automatic—or any other system now or hereafter invented, as the most important. This was an amendment to a law passed in 1907 giving the commission power to compel steam roads to install "proper blocking" systems. Because the roads and the commission could not agree on what constituted "proper blocking" nothing has been done, although suits are pending to that end.

The new Senator Netterville wire law regulating the manner of suspending telephone, telegraph and electric light wires over railroad tracks is held to be important by the commission. The law provides that all such wires crossing one another and suspended over tracks must be of either aluminum or copper between two posts on either side of the crossing point; that the span must not be more than 100 ft. long and suspended at least 21 ft. above the tracks. The act will not affect wires already in use if found in safe condition.

Massachusetts Legislative News.

Hearings have recently been continued on the project of the Boston & Eastern Electric Railroad Company, which desires to build a high-speed interurban line between Boston, Lynn and Salem. Evidence brought out at the latest hearing tended to show that the building of the Boston & Worcester Street Railway Company's line parallel to the Boston & Albany Railroad had resulted in mutual benefits and a larger tide of travel in the territory covered. Chief Engineer Bickford, of the Boston & Eastern, stated that the local street-railway service north of Boston cannot handle the traffic from the standpoint of through service as quickly as the proposed road, and said that in the past five years there had been no reduction of moment in the running time of the local trolley systems. Opposing counsel contended that the financial backing of the proposed line has never been made public, and urged that the traffic possibilities in the territory are insufficient to justify the construction of the road. It was argued that serious injury would be done to the existing systems of steam and street-railway lines if the road should be built. The promoters of the road are trying to secure legislation compelling the Railroad Commission to grant them a certificate of exigency.

At a hearing given last week by the committees on railroads and street railways of the Massachusetts Legislature Mr. T. E. Byrnes, vice-president of the New York, New Haven & Hartford Railroad Company, outlined the plans for electrification which are to be put into effect in case the State permits the New Haven interests to purchase the Boston, Revere Beach & Lynn Railroad. Mr. Byrnes said that if the merger is permitted a tunnel will be built under Boston Harbor which will permit the operation of long-distance through trains in the Boston district by electricity. The Revere Beach road would be electrified. Rapid transit will be provided in electric trains between the heart of Boston and the North Shore district, including the cities of Lynn and Salem. It is also proposed to make a connection between the electrified Revere Beach & Lynn system and the Boston Elevated Railway Company's system through the existing East Boston tunnel.

Wisconsin Commission News.

Representatives of the Argyle Telephone Company appeared before the Railroad Commission on March 6 in an application for an increase in rural rates from $3 per subscriber per year to $6 per subscriber per year. There was no opposition.

In the case of Sarah M. Cawker and others against the commission the Circuit Court has decided that the plaintiff's heat and lighting plant in Milwaukee is not a public utility and therefore not subject to commission control and regulation. This case was carried to the court in answer to the threat that the commission would cause the Cawker Heating Company to be prosecuted if it failed to comply with the requirements of the Public Utilities law. The plaintiffs own and operate a heating plant in connection with the Cawker Building, which furnishes heat, light and power to the building. The plant was installed and maintained by the plaintiffs to meet their own demands, and finding that it created more energy than was necessary for their needs they entered into an agreement with three tenants to furnish them with power. The question of whether or not this constituted a public utility, subject to commission control, was decided in the negative by the court.

This decision has shown the necessity of a more definite law as to what constitutes a public utility or an act which will give the commission authority to determine for itself the facts in any particular case. Although in the present case, considered as an isolated one, question might arise as to the plant being in reality a public utility, when it is considered that in the City of Milwaukee, for example, there is a considerable number of just such cases, and that, furthermore, the individual

tenants may be large consumers, as was true in the Cawker case, and that every case takes the form of competition with an existing utility which is under commission control and must obey the Public Utilities law, it is evident that the question takes on an entirely different aspect.

Where the line must be drawn seems to hinge upon the motive which prompted any individual to sell his surplus energy. A case might be mentioned of where an individual a couple of years ago supplied his neighbor with energy. This was not considered a public utility. Soon, however, he supplied two neighbors and now he is supplying two entire blocks When did the plant become a public utility?

The commission has granted the petition of the Bloomer Electric Light Plant for authority to put into effect a new schedule of rates. This case has been before the commission on several previous occasions. At the last appearance the commission insisted that the petitioner proceed to take the necessary steps to make the service reasonably adequate before any serious consideration could be given the question of rates. The defects in the system were due in a large measure to the plaintiff's poor power facilities. Acting upon the commission's advice the Bloomer plant has been incorporated, an indeterminate permit secured from the commission and a transmission line constructed to the plant of the Chippewa Falls Valley Railway, Light & Power Company, at Chippewa Falls, from which company power is now being received at Bloomer and supplied to the consumers by the petitioner. The inspectors reported the service to be entirely satisfactory. The rates granted are as follows:

Lighting Rate.—Twelve and one-half cents per kw-hour for the first fifty hours' use of the active connected load; 8 cents per kw-hour for all in excess. In Class A, consisting of residences, the active load is to be considered as 60 per cent of the total connected load when the total connected load is equal to or less than 500 watts nominal rated capacity; when the installation exceeds this value 33⅓ per cent of such part of the total connected load over and above 500 watts is to be considered active. In Class B, consisting of offices, business houses, etc., 80 per cent of the connected load is to be considered active. In Class C, consisting of certain designated consumers, 55 per cent is to be active.

Power Rate.—Six cents per kw-hour for the first fifty hours' use of the maximum demand and 3 cents per kw-hour for excess. The maximum demand is to be taken as the rated capacity of the motors installed, unless the consumer desires to install an approved maximum-demand indicator at his own expense.

Municipal Lighting.—When 32-cp tungstens are to be used the rate is to be $18 per lamp per year for a service of approximately 4000 hours. For 6.6-amp inclosed arcs the rate is to be $85 per arc per year on the basis of approximately 4000 hours' burning.

The minimum bill is to be 50 cents. The new schedule amounts to a decrease in rates for commercial consumers as a whole and an increase for municipal lighting.

New York Commission News.

The Public Service Commission, Second District, has received a complaint from the village officials of the village of Lyons directed against the Wayne Telephone Company on account of the raise in rates made in that village on March 1. Up to that time the rate had been $15 per year for residence telephones and $18 for office or business places. The rate for office and business houses has been raised to $24 for four-party line, $27 for two-party line and $30 for single-party line. The complaint has been served upon the company and an answer required on April 15.

An application has been filed by the Long Island Lighting Company, a new corporation, asking for approval of the purchase of the entire property and franchises of the Amityville Electric Light Company, the Sayville Electric Company, the Northport Electric Light Company and the Islip Electric Light Company, and their merger into the Long Island Lighting Company, and for leave for the new corporation to execute a mortgage covering the properties of the constituent companies and to issue stocks and bonds thereunder. The companies in question operate in the town of Oyster Bay, village of Amityville, town of Babylon, village of Sayville, town of Islip, village of Northport and town of Huntington. The aggregate price to be paid for the property is $308,672. It is proposed to issue capital stock amounting to $300,000 at par and first-mortgage bonds to the amount of $370,000 at a price not less than 85. The proceeds of the sale of the securities are to be used for the purchase of the property and new construction, additions and betterments to the amount of practically $300,000. The proposition is to build a high-tension transmission line from Northport to Islip and there branch off to the west, connecting with Bay Shore, Babylon and Amityville; also to the east, connecting with Sayville, and later on to construct a branch line from Northport through Commack to Smithtown and St. James. It is also proposed to construct a line connecting with Brentwood, Central Islip, Ronhonkoma, Bohemia and Commack, none of which towns are now supplied with electricity; also to construct street-lighting systems in Islip, Central Islip, East Islip and Brentwood. Important improvements are proposed for the Amityville, Islip, Sayville and Northport stations.

New Jersey Commission News.

The Board of Public Utility Commissioners for the State of New Jersey has received a complaint from E. C. Hinck, Mayor of Montclair, N. J., alleging that the charge made by the New York Telephone Company for four-party-line service is $2.50 per month while in White Plains the charge for similar service is $2 per month. It is claimed that there are approximately 4000 subscribers in Montclair as compared with 2200 in White Plains.

Following a hearing upon the complaint of the City of Trenton the board has issued an order to the Trenton Street Railway Company requiring a large amount of reconstruction and repairs to be done.

The board has given conditional approval to leases of the Trenton Street Railway Company, Trenton, Hamilton & Ewing Traction Company, Mercer County Traction Company and Trenton, Pennington & Hopewell Street Railway Company to the Trenton & Mercer County Traction Corporation.

The board has granted the following certificates of approval: Shore Electric Company, issuance, sale and delivery of $341,500 bonds; Bogota Water & Light Company, ordinance, township of Teaneck, granting a franchise; Delaware & Atlantic Telegraph & Telephone Company, ordinance, borough of Woodbine, granting a franchise.

Maryland Commission News.

The Maryland Public Service Commission has granted permission to the Consolidated Gas, Electric Light & Power Company, of Baltimore, to issue $1,500,000 new stock, $735,000 to be used in taking up prior-lien preferred stock and $765,000 to be used for acquiring additional property, construction, completion, extension and improvement of its plant, subject to an order requiring the company to report to the commission each step in the use of the funds. Mr. S. Gross Horwitz, appearing as an individual, entered a protest on the ground that the grant would have the effect on the public mind of a sanction by the commission of the previous issues of the company and also embarrass the commission when the city's complaint is filed, as the company might plead such implied sanction, while the stock, being mingled with the previous issues would be put at a disadvantage through representing an actual cash investment. The commission did not take this view, as the funds were for legitimate purposes and the sanction of the commission in authorizing this issue carried with it no sanction beyond its approval of the purposes for which this issue was asked. The

investor would purchase the stock, said the commission, with the knowledge of the impending complaint of the city and of the consequences that flowed from it. The order required that the corporation shall report to the commission upon the sale for cash of the common stock authorized and approved, or any part thereof, the fact of such sales, the terms and conditions thereof and the amount realized therefrom; and that at the termination of each period of six months from the date of the order the disposition and use made of the proceeds of the stock and the facts and circumstances as to the property acquired and the construction, completion, extension and improvement of its facilities be reported.

The Consolidated Gas, Electric Light & Power Company has filed a reply with the commission to a complaint charging refusal to extend gas mains except on the payment of $200 toward the expense of construction. The company's reply states that the house in question is 650 ft. beyond its terminus and that but two uncompleted houses lie between. A proposition was made by the company whereby it would bear the expense for 100 ft. for each cottage, provided the complainant would deposit $200 with the company to be refunded to him upon the erection of several other cottages in that block.

City Solicitor Poe has conferred with Chairman James M. Ambler, of the Public Service Commission, in order to arrange for the commission to make a valuation of the Consolidated Company's physical investment in the electric and gas business. This action by the city solicitor was made necessary for the reason that Prof. Charles E. Munroe, the city's gas expert, in preparing his report as to the proper gas rates for Baltimore, was unable for lack of sufficient authority to get this information from the books of the company. While the commission has taken no steps on the request of Mr. Poe, it is understood that it will agree to gather the information desired.

Canadian Hydroelectric Commission News.

The negotiations which have been carried on since last fall between the representatives of the City of Toronto and the Toronto Electric Light Company relative to either the purchase by the city of the company's plant or an arrangement for harmonious working between the company's plant and the city's new hydroelectric system, consequent upon the introduction of Niagara power to the city, have culminated in an offer being made by the city corporation to purchase the company's property and effects at the rate of $125 per share of the company's stock, of the par value of $4,000,000, as well as the assumption of the bonded debt of $1,000,000, making a total purchase price of $6,000,000.

In an official statement by Mayor Geary, on March 10, it was stated that the proposition was subject to the consent of the Hydroelectric Commission and to such a rearrangement of the city's obligation to the commission and other municipalities as will enable the city to take a maximum of 15,000 hp and a minimum of 7500 hp from the Electrical Development Company; and a rearrangement of that company's contract with the Toronto Electric Light Company so as to limit the liability of the latter and of its successor to the city to take only a minimum of 7500 hp at the contract rate up to the expiration of the company's franchise in 1919. Comptroller Ward dissented and would not consent to negotiate further with the company.

The Toronto Electric Light Company has issued a statement in which it states that, in order to meet the wishes of the city, the company will agree to forego the rest of its franchise period, which expires in 1919, and to sell out to the city at a price to be decided by arbitration. It pointed out that the H. M. Byllesby Company, of Chicago, and W. F. Wells, of New York, had placed the value of the physical assets of the company at $7,500,000, and the value of the stock at $200 per share. Mr. Alexander Dow, of Detroit, then made an investigation for the city and found that, admitting the value of the physical assets to be $6,000,000, the value of the stock to the company was $150 per share. Finally, the experts for the Hydroelectric Commission, and Mr. R. A. Ross, of Montreal, made an investigation and found that the replacement value of the company's property was $6,500,000, the value of its stock being placed at $125 per share. The company states that in the case of a property like that in question it is impossible that there should be a divergence in real values to such an extent as between $200 and $125 per share. The company offers to arbitrate either by the usual arbitration contemplated by the existing agreement between the city and the company, or by a speedy arbitration by three independent parties, one to be selected by the city, one by the company and one by the government, or by reference to three of the most noted American engineering firms, namely, Westinghouse, Church, Kerr & Company, of New York; Stone & Webster, of Boston, and Sargeant & Lundy, of Chicago, or any other engineering firms of high standing to be named jointly by the president of the American Institute of Electrical Engineers and the president of the University of Toronto.

CURRENT NEWS AND NOTES.

Public-Service Commission for Kansas.—It is reported from Topeka, Kan., that the State Senate has adopted the conference report, making it practically certain that the bill creating a board to have charge of all public utilities in the State will become a law.

Meetings of Electrical Inspectors.—A movement is on foot in the Rocky Mountain territory to have regular meetings of the electrical inspectors of the various cities for the purpose of securing to the greatest possible extent uniformity in the interpretation of the National Electric Code and for the suggestion of additional rules for the promotion of construction methods.

Chicago Party to Electrochemical Convention.—It has been arranged that Chicago visitors to the semi-annual meeting of the American Electrochemical Society in New York on April 6-8 may leave on special cars on the Michigan Central Railroad at 5 p. m. on April 4, stopping over the next day at Niagara Falls and arriving in New York at 7:50 a. m. on April 6. Mr. Arba B. Marvin, secretary of the Chicago Section, 950 Commercial National Bank Building, is making the arrangements.

Engineering Society of Wisconsin.—The third annual meeting of the Engineering Society of Wisconsin was held at Madison, Wis., on March 8, 9 and 10. Among a number of papers was one by Mr. O. M. Rau, of Milwaukee, on "Use and Maintenance of Joint-Pole Lines by Public-Service Companies." Mr. J. N. Cadby discussed the methods of the Wisconsin Railroad Commission, and Prof. J. W. Shuster, of the University of Wisconsin, presented a very brief report on electrical engineering. Mr. F. G. Simmons, superintendent of way of the Milwaukee Electric Railway & Light Company, was elected president of the society.

The Power-Factor.—A regular meeting of the Boston Edison Company Section of the National Electric Light Association was held at the Edison Building, Boston, March 7, with Mr. R. E. Curtis in the chair. Dr. Louis Bell gave an interesting talk on "Power-Factors," describing early induction-motor designs, giving reminiscences of subsequent motor development with the reasons for the abandonment of former types of machinery, and closing with a graphic treatment of the effect of power-factor on alternating-current systems, including means of correcting a poor power-factor, and also touching upon the tendency of companies in some sections of the country to adjust their rates with regard to the power-factor of the consumer. Following Dr. Bell's address a short discussion was participated in by Messrs. R. S. Hale, L. L. Elden, J. H. Vahey, F. C. Hard and T. E. Penard.

Liberia-Brazil Cable.—The laying of a cable between Monrovia, Liberia, and Pernambuco, Brazil, began on March 6. This cable represents the final stretch in the line which is to connect Germany directly with South America.

Corporation Tax Enforcement.—The Supreme Court has handed down a unanimous decision affirming the constitutionality of the corporation tax law. Public service corporations are held to be within the scope of the statute in spite of their quasi-public nature.

Test of Electric Meters.—The total number of electric meters tested upon complaint by the New York Public Service Commission during February was seventy-seven. Of these 2.6 per cent were more than 4 per cent fast, 3.9 per cent more than 4 per cent slow, and 93.5 per cent within the law requirements of between 4 per cent fast and 4 per cent slow.

Safety in Railroad Travel.—According to reports issued by the Pennsylvania Railroad Company giving accident statistics for the years 1908, 1909 and 1910, not one passenger of the 136,000,000 carried in 1910 was killed in a train accident. During the three years mentioned 371,858,277 passengers were carried and only one was killed as a result of a train wreck.

Destruction of Generating Station by Snowslide.—According to reports from Carson, Nev., the generating station of the Hydroelectric Company at Jordan, Mono County, Cal., has been destroyed by a snowslide which wrecked the building, killed eight men and injured several others. The plant, which was not fully completed, was to furnish electrical energy to Rawhide, Aurora and other central Nevada mining camps.

A. I. E. E. Nominations.—The following ticket has been slated by the board of directors of the American Institute of Electrical Engineers as a result of a canvass of the membership, the figure after each name indicating the number of votes received by each nominee: For president, Mr. Gano Dunn, 993; Mr. Ralph D. Mershon, 590; for vice-presidents, Mr. D. B. Rushmore, 536; Mr. C. W. Stone, 499; Mr. W. G. Carlton, 399; for managers, Mr. F. S. Hunting, 340; Mr. Farley Osgood, 245; Mr. N. W. Storer, 155; Mr. W. S. Lee, 109; for treasurer, Mr. G. A. Hamilton, 1294; for secretary, Mr. Ralph W. Pope, 1309. The officers to be elected are one president, three vice-presidents, four managers, a treasurer and a secretary.

A. S. M. E. Meeting in Pittsburgh.—Extensive preparations are being made by the local committee for the spring meeting of the American Society of Mechanical Engineers to be held in Pittsburgh May 30 to June 2. An attractive booklet will be issued containing full information as to the program, excursions and the industrial plants to be visited. Messrs. E. M. Herr, vice-president of the Westinghouse Electric & Manufacturing Company, and E. K. Hiles, secretary of the Society of Engineers of Western Pennsylvania, are chairman and secretary respectively of the local committee in charge of the arrangements. The society has in the neighborhood of 200 members in the Pittsburgh district and a large attendance is anticipated at the meeting.

Wireless Interference with Lighting.—The wireless telegraph outfit of two Denver boys has been putting the electric lighting fixtures of their neighborhood up to queer capers for several weeks. About 3 o'clock in the afternoon, or just as the boys got their wireless apparatus working, the fixtures in nearby houses would sputter and sizzle and pop, and sometimes in the evening there would come a lond bang and out would go the lights. This mystified inhabitants of that part of the city, who carried complaints to the Denver Gas & Electric Company, the result of which was an investigation and the discovery of the wireless apparatus. The Gromm machine derived its power from one of the electric company's feed wires and the "kick-back" current from the apparatus is supposed to have caused the trouble in other folks' houses. One of the wireless operators, Mr. William S. Gromm, won first prize in the last Denver electrical show last year for a wireless outfit.

Lectures on Electricity.—The Department of Education of the City of New York has included among its public lectures a number on electricity which will be delivered during March and April. Mr. Charles L. Harrington will deliver at the public school at 320 East Twentieth Street nine lectures on "Magnetism and Electricity" on consecutive Fridays, beginning March 3. Mr. W. Wallace Kerr will deliver the same number of lectures on "Principles and Practices in Electrical Engineering" on nine consecutive Thursdays, beginning March 2. There will be a series of lectures on electricity also in Queens County by Mr. J. Newton Gray, on Fridays, at the New Town High School; by Mr. W. Wallace Kerr at Public School No. 58 on Wednesdays and by Mr. F. W. Huntington at Public School No. 8 on Fridays. Mr. Huntington will also deliver lectures at Public School No. 14, Stapleton, S. I., on Fridays. In each case the lectures begin promptly at 8:15 p. m. The lectures are intended for the benefit of the general public, school children not being admitted.

Meeting of New York Companies Section, N. E. L. A.—The fourth regular monthly meeting of the New York Companies Section of the N. E. L. A., embracing employees of the New York Edison Company, United Electric Light & Power Company, Westchester Lighting Company, Yonkers Electric Light & Power Company, Bronx Gas & Electric Company, Peekskill Lighting & Railroad Company, Richmond Light & Railroad Company, Flatbush Gas Company, New York & Queens Electric Light & Power Company, Northern Westchester Lighting Company and Queens Borough Gas & Electric Company, will be held in the Edison Auditorium, 44 West Twenty-seventh Street, New York, on March 20. Mr. Walter R. Addicks will deliver an illustrated lecture similar to one recently delivered at Johns Hopkins University entitled "The Story of Gas from the Coal in the Mines to the Finished Product," including a description of various systems of distribution. At the conclusion of the lecture there will be music, entertainment and refreshments.

Canadian N. E. L. A. Commercial Section.—Mr. Eugene Creed, chairman of the Commercial Section of the Canadian Electrical Association (in affiliation with the N. E. L. A.), has appointed the following as chairmen of the several commercial committees: Mr. W. F. Dean, Canadian General Electric Company, Toronto, committee on heating, refrigeration and kindred appliance sales; Mr. N. A. Braden, Westinghouse Company, Hamilton, Ont., committee on the functions of a sales department; Mr. L. W. Morden, Canadian Westinghouse Company, Toronto, committee on electrical vehicles; Mr. R. G. Black, Toronto Electric Light Company, committee on improved wiring and improved standards; Mr. A. E. Fleming, Nernst Lamp Company, Toronto, committee on residence business; Mr. A. M. Fisher, *Electrical News*, Toronto, committee on advertising; Mr. S. G. Redway, Toronto Electric Light Company, Toronto, committee on sign lighting; Mr. F. A. Chisholm, St. Johns Electric Lighting Company, St. Johns, Que., committee on electricity in rural districts; Mr. H. G. Nichols, Factory Products, Limited, Toronto, committee on industrial lighting; Mr. R. F. Pack, Toronto Electric Light Company, committee on membership; Mr. W. L. Bird, Kaministiquia Power Company, Fort Williams, Ont., committee on power; Mr. Thomas F. Kelley, Hamilton Electric Light & Power Company, committee on street lighting; Mr. Edward B. Pike, Tungstolier Company, Toronto, committee on competitive illuminants.

Lighting of County Buildings in Los Angeles.—It is suggested that Los Angeles County install an electric plant to supply energy, principally for lighting, to the new Hall of Records, Hall of Justice, court house and jail. By utilizing steam from the 600-hp boiler plant in the Hall of Records it is estimated that the plant could be erected at a cost of about $18,000. The Board of Supervisors has the matter under consideration.

Electricity Kills a Wire Thief.—An unidentified man was found dead on a bank of the North Channel of the Chicago Drainage Canal on March 8. He had been killed apparently by electric shock. The body lay near a pole supporting a transmission line from which about 300 ft. of copper wire had been stolen. The police believe that the man was assisting others to cut the wire and that his accomplices abandoned him when he received the fatal shock.

Municipal Plant for San Bernardino Proposed.—The City Council of San Bernardino, Cal., is considering the advisability of purchasing an electric lighting plant for municipal service. As a result of the offer of the Lytle Creek Power Company to sell its generating plant and distributing system to the city the bids for street lighting recently asked will be held in abeyance until a definite decision is reached in relation to the possibility of the city's owning its own plant.

Association of Railway Electrical Engineers.—The semi-annual convention of the Association of Railway Electrical Engineers will be held June 16 and 17 in Washington Terminal Station, Washington, D. C. The annual convention will be held in Chicago from Nov. 6 to 10. The entire nineteenth floor of the La Salle Hotel, Chicago, has been reserved for the meeting and exhibits by members of the Railway Electrical Supply Manufacturers' Association. Mr. Joseph A. Andreucetti, 323 Kinzie Street, Chicago, is secretary of the association.

Fire in Racine Central Station.—The Racine (Wis.) station of the Milwaukee Electric Railway & Lighting Company was damaged by fire on the evening of March 10. The origin of the fire is not known. The roof of the building was burned off, but the remainder of the damage was mainly to the switchboard. The loss is estimated at $15,000, newspaper accounts of the fire being exaggerated. From this station energy is distributed for commercial electric service in Racine, as well as for the operation of the local electric railway, and these utilities were suspended on the night of the fire. Temporary connections were made, however, which enabled the resumption of service within twenty-four hours.

Colorado 18,000-hp Hydroelectric Plant.—The large plant of the Colorado Electric Power Company at Nederland, in Boulder County, Col., will be placed in commission April 1, according to present plans of the company. This plant is capable of generating 18,000 hp, and is one of the largest in the West. The only plant of the company now in operation is that at Shoshone, on the Grand River, just above Glenwood Springs, which generates 20,000 hp. Plans for making numerous extensions of the company's transmission lines throughout western and central Colorado have been approved by President G. H. Walbridge. These will be begun this summer and will cost eventually between $300,000 and $400,000, or approximately $1,000 a mile.

Proposed Public-Service Commission in Illinois.—The Rawleigh bill in the lower house of the Illinois Legislature giving the State Railroad and Warehouse Commission jurisdiction over public utilities in cities having less than 200,000 population is in charge of the municipal corporations committee, of which Representative L. I. Butts is chairman. The first hearing of the committee was held on March 7. Mr. I. C. Vopley, of Aurora, president of the Western United Gas & Electric Company, which is said to have franchises in thirty-nine towns, and Mr. Frank J. Baker, of Chicago, vice-president of the North Shore Electric Company, which serves a territory including seventy-one cities and villages, appeared among others to favor the bill. A representative of the mayors' organization of Illinois opposed the bill on the ground that it would take even the control of municipal waterworks from the city councils and vest it in the commission. Other hearings on this bill will be held.

Telharmonium in Operation.—Arrangements are now being completed for the removal to New York in the near future of the Cahill telharmonic plant for the production and distribution of music electrically which has been erected at Holyoke, Mass. A description of this plant was given in our issue for April 28, 1910, while descriptions of the former New York plant, which the present plant supersedes, appeared in our issues for March 10, 1906, and Jan. 5, 1907. On March 3, 1911, the plant transmitted music from Holyoke to Springfield, Mass., to the very evident delight of an audience of about 650 persons gathered at a banquet of the Board of Trade. On March 3 music was again transmitted to Springfield for an audience at the Winthrop Club. Transmitted music was a prominent feature of a banquet given by the Board of Trade of Holyoke to Governor Foss, on March 6, when the telharmonium in a different part of the city was used with striking success to accompany the singers who entertained the guests.

University of Illinois Contemplates New Engineering Building.—The University of Illinois, of Urbana, Ill., is asking the State Legislature for an appropriation of $5,500,000 to provide for the needs of the university in all departments for two years. Of that sum $600,000 is asked specifically for the engineering department, although some of the expenses of this department will be paid from the general university fund. Of the $600,000 asked for the engineering department $300,000 is for operating expenses and maintenance for the two years, while $300,000 is asked to provide money for a new engineering building and its equipment. Much valuable research work is carried on at the engineering experiment station of the university, and the authorities of the institution feel that the State should deal liberally with its university if its greatest usefulness to the people of the State is to be attained. If the tax rate were increased to add $3,000,000 to the revenue of the State, the increase in the tax rate in Cook County, including Chicago, would be about 1 per cent of the present rate. The appropriation made for the university two years ago was $2,250,000, although $3,500,000 was asked. The much increased amount now sought is due largely to the needs of the agricultural department.

Commercial Relations with Japan.—At the mid-week lunch of the Colorado Electric Club on March 9 Dr. A. L. Bennett, Japanese consul, gave a talk on possibilities for the advancement of the commercial relations between the United States and Japan. By the presentation of figures and quoted statements from Japanese merchants Dr. Bennett showed our little chance of gaining trade in the Orient so long as we depend on English catalogs and slow extension of credit in the face of the active campaign through traveling salesmen and rapid investigation of credit by foreign manufacturers. In the face of poor methods, he stated that we now hold second place in total exports to Japan and first in electrical goods, but that we cannot retain this position with present methods, though we might easily improve it by adoption of better commercial attitude since, other things being equal, our goods are the most sought after. This talk was followed by a short statement from Mr. N. Tatsukawa, who spoke of the recently issued report of the Japanese Commercial Commission on its trip among United States manufacturers, and the especially good impression given by the extensive development of electrical power and illumination in Denver particularly. One hundred and two were present at the lunch.

LEHIGH VALLEY TRANSIT COMPANY.

Steam Turbine Station at Allentown, Pa., Supplying Energy to Lighting and Railway Circuits in Allentown, Bethlehem, Nazareth, Slatington and Contiguous Country.

THE Lehigh Valley Transit Company operates in a country rich in historic interest and embracing not only cities with wide and varied manufactures, but also the heart of the cement and slate industry. The company is a consolidation of the Lehigh Valley Traction Company, Allentown & Slatington Street Railway Company and Coplay, Egypt & Ironton Street Railway Company, and owns outright and operates 126 miles of electric railway in addition to twenty miles under lease. The company also owns a majority of the capital stock of the Allentown Electric Light & Power Company, which operates under lease the Bethlehem Electric Light Company and the South Bethlehem Electric Light Company. The central-station business of Slatington and Emaus is managed by local companies of which the Lehigh Valley Transit Company owns all the stock. The central-station field has been developed by a carefully organized commercial and soliciting force, which brings the company into close touch with its present and prospective customers and provides careful supervision of the business, which has increased largely during the past year as a result of this organization. The generating station for the entire system is located on the Lehigh River at Allentown. It is equipped with modern steam-turbine generators having a maximum rating of 11,625 kw, and a 6000-kw unit (6700 kw maximum) is at present being added, which will bring the total maximum rating of the station to 18,325 kw by July of this year. Two additional boilers are also being installed to take care of the extra load. There are eight substations on the railway system, all modern, well equipped and advantageously located.

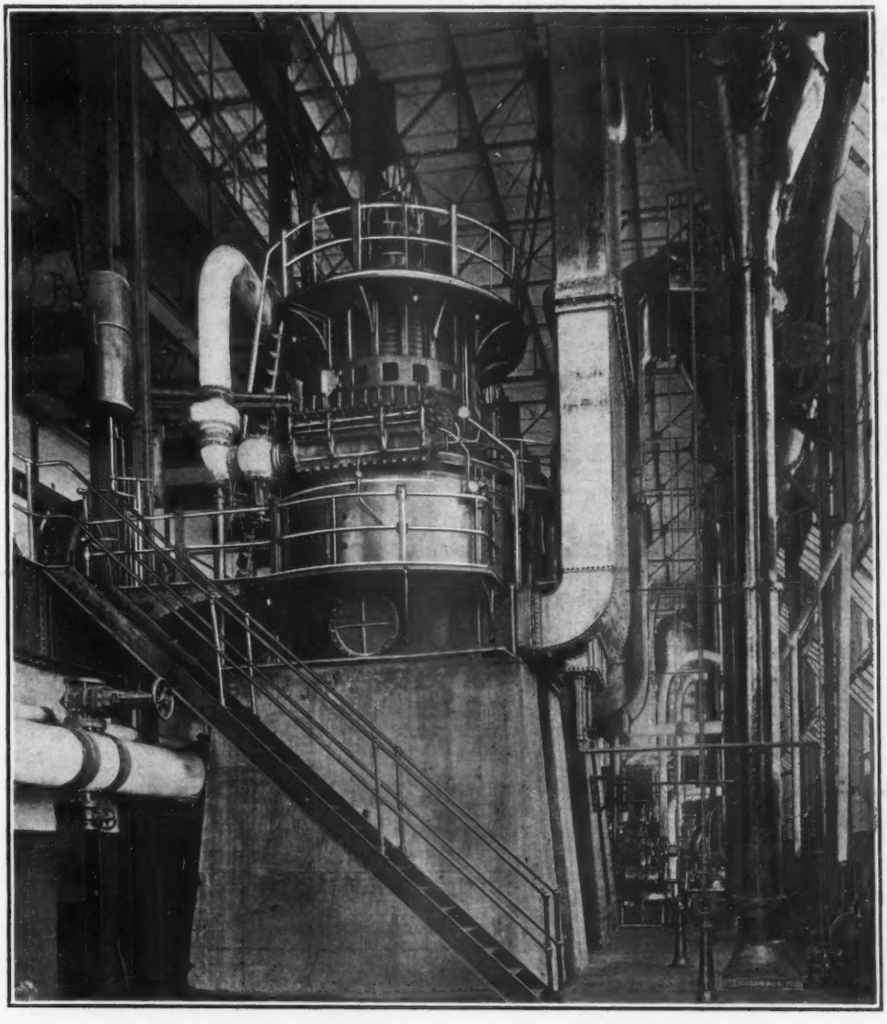


Fig. 1—General View of Turbine-Room, Lehigh Valley Transit Company.

As a result of the successive growths of the various companies the generating stations prior to the erection of the central plant were widely scattered and the equipment not at all uniform. Railway stations were operated at Allentown (2500 kw), Quakertown (350 kw), Souderton (350 kw), Ambler (350 kw), Broadheads (400 kw) and Slatington (600 kw). Lighting stations were located at Slatington (100 kw), Allentown (1000 kw) and Bethlehem (500 kw). In addition there was a 200-amp battery station at Rocky Ridge and a 300-amp station at Allentown. The existing incandescent lighting systems were operated at 133 cycles and the street-lighting circuits fed in the main open-arc lamps supplied with energy by 9.6-amp Brush machines in the Allentown and Bethlehem stations.

In the choice of distributing and operating systems and frequency for the generating plant certain considerations largely determined the choice for the respective services. On the service lighting system, for instance, most of the transformers installed were suitable for operation at 60 cycles, although then used at 133 cycles. To discard these would have entailed a loss, and furthermore would have resulted in great inconvenience when changing over from the old system to the new. The necessity of maintaining the service and of bettering it as rapidly as possible was more than ordinarily important. The arc-lighting situation was somewhat complicated by reason of existing contracts which definitely specified the type and form of lamp. These were of such a nature as to make it desirable to retain the existing system for that service even at the expense of some complication in the station equipment.

On the railway system all of the existing lines were operating at 500 volts and the character of the service and the existing construction determined the retention of this system for the operation of the railways. Some of the local motor users in Allentown were equipped with 500-volt drives, which required the provision of a 500-volt metallic circuit, the intention being gradually to reduce this service to a point where it could be discontinued and the apparatus provided for that service be subsequently converted to the use of the railway system. The unfavorable location of the stations outside of Allentown as regarded both fuel and water supply (which in most cases had resulted in their operating non-condensing) determined the choice of a single centrally located station at Allentown, on the south bank of the Lehigh River, with railroad connection from the Lehigh Valley Railroad providing an ideal situation as regards both the coal and water supply.

The three-phase, 25-cycle, 13,200-volt transmission to the railway substations was settled upon because of the contemplated connection with the transmission of adjacent systems

operating at this frequency. The importance of this over-balanced the desirability of having a single frequency in the generating station.

For the lighting system of Bethlehem and Slatington independent three-phase, 60-cycle, 13,200-volt transmission lines are

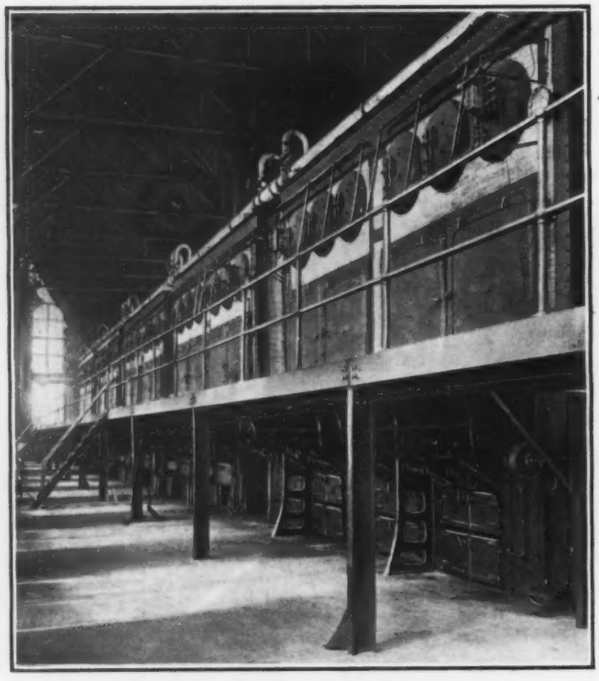


Fig. 2—Main Floor of Boiler-Room.

carried to the respective substations, a single copper line being installed for Slatington and a double line for Bethlehem. In the construction of the various lines bare copper wire, ranging from No. 2 to No. 00, is employed, the insulators being triple-petticoat porcelain, 70,000-volt test, with locust pins. For the majority of crossings the standard strain-insulator construction is employed, the belief being that the simplest possible arrangement will give the greatest security from trouble.

In the selection of the power-house site at Allentown there were a number of governing features to which consideration had to be given. The necessity of supplementing the existing station by the use of such new equipment as could be quickly placed in service limited the choice of location to a plot adjacent to the then existing railway station, while the character of the site necessitated the overlapping of both stations. Moreover, the great quantities of coal dust, mud, etc., brought down at times of high water by the Lehigh River and deposited in its old basins was a factor in considering the water supply. Another consideration to which some weight had to be given by reason of numerous coal strikes at the time the station was designed was the provision of a large reserve coal storage. As the railroad connection crosses one of the city streets, some system of receiving coal whereby frequent shifts would not be required was necessitated. The extended system of coal pits capable of receiving a train of cars was, therefore, determined upon and there was installed an electrically operated gantry crane with one end traveling on the coping of the building wall for handling the coal from the pits to the storage bins or stokers.

As shown in Fig. 3, the crane carries at the building end a suspended hopper into which a clam-shell bucket discharges. Immediately beneath this hopper and entirely inclosed from the weather are duplicate electrically driven coal crushers. The fuel is then discharged into the lower hopper, provided with cut-off valves, one of which is located for loading into a charging larry traveling on bracket runway at the side of the building, while the other valve discharges into an emergency storage pile of crushed coal. The bulk of the coal is, of course, stored uncrushed, the area provided being sufficient to accommodate a three-month supply. One man ordinarily attends to the coal handling.

On account of the character of the soil it was necessary to carry the entire building and the machine foundations on piles. The latter were cut off below minimum water level. At the same time the great variation in the river level necessitated very deep foundations in order to raise the lower floor of the station to a point which is secure against floods. The building is of skeleton-steel construction, with monolithic concrete walls, roof and floors. It is fireproof in every regard, as the doors and windows are of metal glazed with ribbed wire glass. The efficient lighting and ventilation of all portions were carefully considered, and practically every portion of the building, including the switch galleries and the boiler-room, is open to the full lighting of the main windows. Monitors are provided for the full length of the building for both the boiler-room and turbine-room to insure efficient ventilation.

An auxiliary coal skip hoist is provided in one corner of the boiler-room. This is arranged to receive coal from the crushed-coal storage previously referred to and to discharge the same into a small hopper at one end of the boiler-room; this is so arranged as to discharge into the same larry car as the discharge hopper on the gantry crane. The charging larry passes along the front of the boilers at the level of the stoker hoppers. This car is a Hunt storage-battery locomotive, the special dumping valve being so arranged as to discharge the coal directly into the

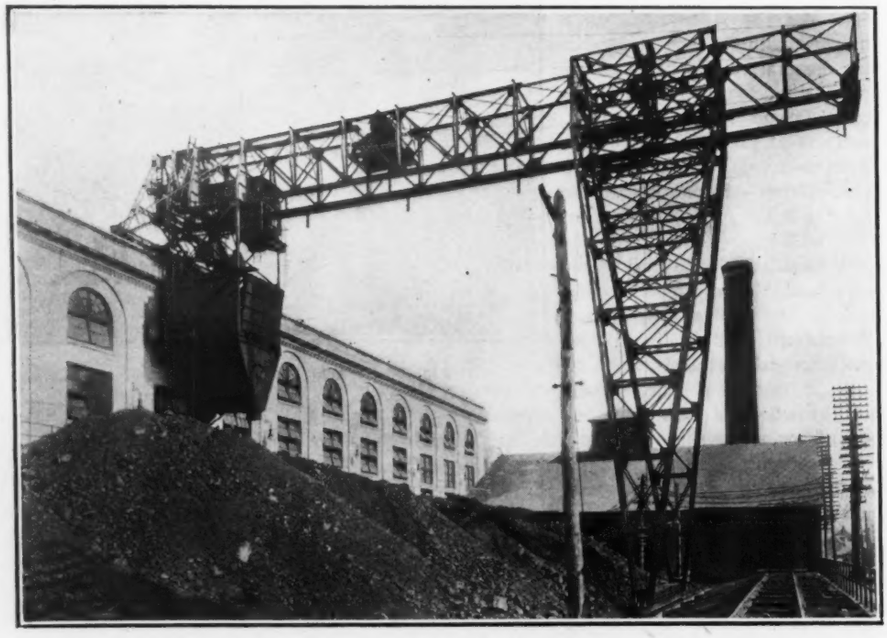


Fig. 3—Coal-Receiving Pits and Gantry Crane Outside Boiler-Room.

stoker hoppers. These hoppers are provided with folding bins, arranged when in the open position to receive a considerable quantity of coal and closing in order to clear the tube doors when open for the removal of tubes. The stokers are of the Roney type, made by the Westinghouse Machine Company.

The boilers consist of six 150-hp batteries of Babcock & Wilcox steel-header type, equipped with two-stage superheaters, designed to give a normal superheat of 200 deg. Fahr. at 200 lb. working pressure. A separate saturated steam system is provided for the station auxiliaries. The boilers connect to a single flue which has dampers at each end of the building and a sectionalizing damper at the center, the design being such that economizers can readily be added without material change at any future time. Two new boilers of similar make and rating are at present being installed at one end of the boiler-room. The boilers are carried on steel and concrete supports, the construction including reinforced-concrete ash hoppers, which discharge directly into cars at the ground level. The steam-piping system of the boiler-room comprises individual connections from the respective boilers into the main steam loop located in the ground story, and similar connections to a central loop system for the auxiliaries. At present a single Custodis radial brick stack 11 ft. x 200 ft. is located at one end of the station; the future stack will be located at the opposite end.

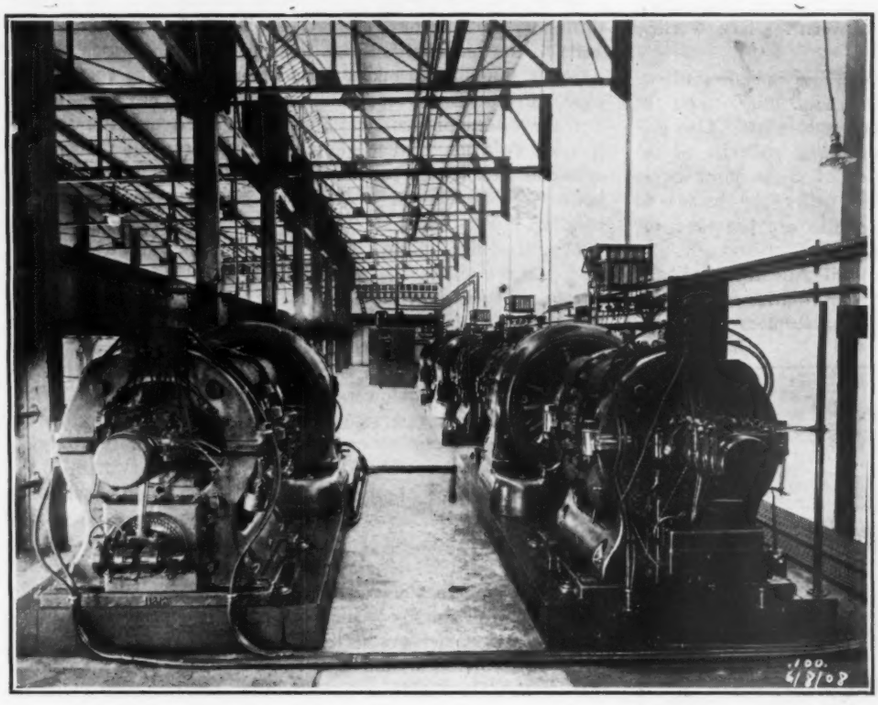


Fig. 4—Upper Gallery of Turbine-Room, Showing Motor-Driven Arc Machines and High Tension Switches and Lines.

The generating equipment consists of two 2000-kw, three-phase, 25-cycle, 13,200-volt railway turbo-generators and one 2250-kw, one 1000-kw and one 500-kw, 2300-volt, three-phase, 60-cycle lighting turbo-generator of the vertical Curtis type, with provision at one end of the station for additional units. The exciting current is provided by two 75-kw horizontal Curtis turbo-generators, which also furnish energy for the station lighting. Provision is made for future motor-driven exciters and frequency changers, one large frequency-changer set being at present installed. There is also provided a storage battery floating on the exciter bus as a guarantee against interruption in the excitation.

The turbines are each equipped with independent Worthington barometric jet condensers, at present supplied from a central centrifugal pumping plant which is located at the center of the station.

The center-crank rotary dry-vacuum pumps, located at the center of the station, are also of the Worthington make. The various pumps for constant-service, boiler-feed, step-bearing and oil-pressure systems are located in the open pumproom immediately beneath the lower switchboard gallery on the main floor. This arrangement secures an extremely light station with the machines accessible. These pumps are of outside, end-packed plunger type and are controlled by automatic governors, the speed of the pump being automatically regulated in accordance with the varying demand. All of the auxiliaries are centrally located on this floor, requiring a minimum of attendance and simplicity of pipe connections. The auxiliaries exhaust into duplicate open Cochrane feed-water heaters located in the boiler-room basement. They embody the Sorge-Cochrane system of feed-water purification. The remaining portions of the ground floor are divided for storage-battery, toilet, lamp-testing and storage-rooms, and the air-blast compartment for the substation transformers.

The center-bay arrangement of circulating pumps for the condensers is at present undergoing modifications, and a part of the bay will be occupied by a 6000-kw Westinghouse double-flow turbine equipped with Leblanc condenser driving a 25-cycle generator. The air leakage in the large cast-iron pipe line connected to the circulating pumps and running along the side wall of the turbine-room near the tops of the condensers was excessive, and in cutting it down to within reasonable limits the

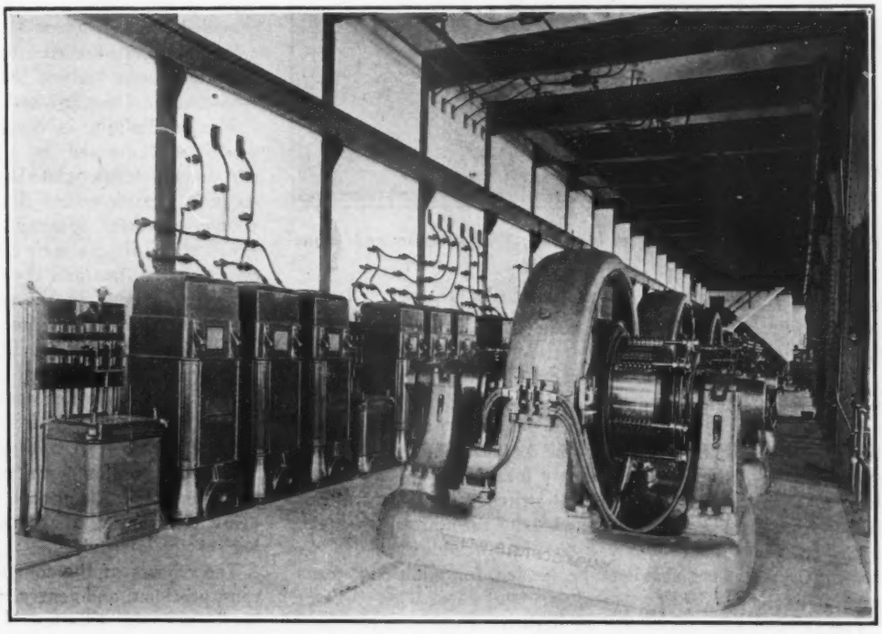


Fig. 5—Railway Apparatus on Lower Gallery of Turbine-Room.

vacuum was reduced a number of inches. The modifications at present being carried out consist in providing independent pumps driven by 90-hp Terry turbines on each of the large units and reclaiming the center space in the generating station for turbo-generators instead of for auxiliary condenser equipment. The new unit now being installed occupies part of the space made available by this change, being placed between the large vertical turbine sets.

On the first gallery of the turbine-room, corresponding in elevation to the main floor of the boiler-room, are located the controlling switchboards, offices and local substation. This gallery connects directly to the lower operating galleries of the respective turbines, the upper galleries of these units being reached from the corresponding lower gallery by means of stairways on each. Suitable platforms also are provided for access to the condenser-control valves, etc.

The substation apparatus for the local Allentown railway service consists at present of three 500-kw rotaries with corresponding banks of step-down air-blast transformers and reactances, the machine and railway feeder panels being located at the adjacent end of the main panelboard as will be noted from one of the accompanying illustrations.

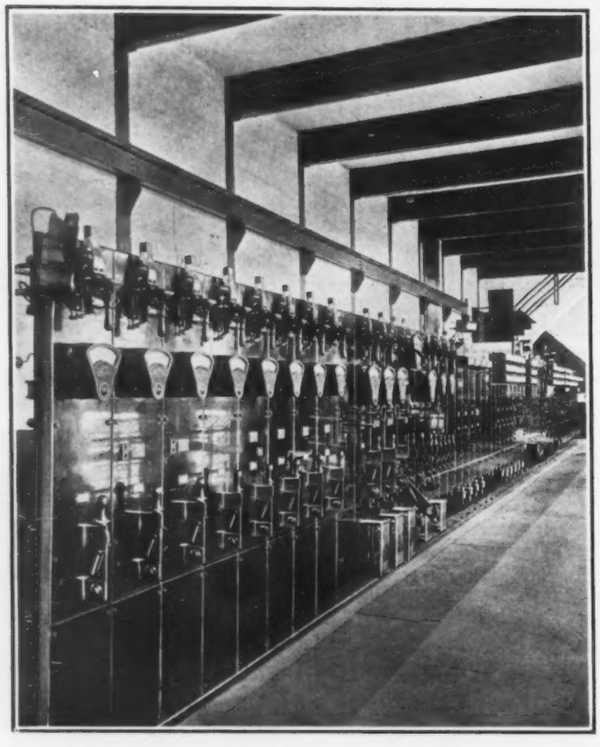


Fig. 6—Main Switchboard for Railway, Transmission and Lighting Circuits.

The upper switchboard gallery is devoted to high-tension switch compartments located at the respective ends of the station, the railway lines being carried out at one end of the station and the lighting lines at the opposite end to terminal towers. The lightning arresters are located on the upper gallery opposite the respective line oil switches. The central portion of the upper gallery is occupied by the motor-driven arc machines, space being provided for future additions, and for step-up transformers that will be needed for additional transmission lines.

The railway substations are all built on a uniform plan, differing only in the number of units provided and in the provision for the lighting distribution in the special cases where this is required. The Bethlehem substation has provision for four railway converters. Those at present installed there are of 300 kw capacity. The layout, however, is such as to provide ample room for 500-kw units should future load requirements demand increased capacity. This station has provision for lighting equipment, a three-wire rotary being provided to meet the requirements of the local metallic circuit direct-current service, which, as above noted, will be sooner or later eliminated. The incoming duplicate high-tension railway lines are carried through remote manually operated oil switches in independent cells to the sectionalized high-tension bus, from which the respective step-down banks of transformers for the rotaries are supplied through corresponding oil switches. The control panels for the alternating-current lines are located opposite the respective switches on that side of the station, while the railway machine and feeder panels, together with the lighting distribution, are located in a group on the opposite side of the building.

The incoming duplicate high-tension lighting lines are handled in a manner similar to that above described for the railway lines, as they are carried through three-phase step-down transformers to a 2300-volt lighting bus, the local motor circuits being distributed at three phase and the lighting at single phase. The transformers in all the substations are of the air-blast type, duplicate blowers being provided in all cases. The arrangement of the straight railway substations is similar to that described excepting only for the omission of the lighting equipment.

The system of connections employed in the main station at Allentown is as follows: There are two 2000-kw, 25-cycle Curtis turbo-generators supplying the railway system, with provision for future installation. These are Y-connected with ungrounded neutral and are each connected through a single remote-control motor-operated oil switch to the 25-cycle high-tension buses, which are sectionalized at the center. The various 25-cycle transmission lines are supplied from this high-tension bus, the duplicate lines on the corresponding divisions being taken from the respective halves of the bus. The 60-cycle, 2300-volt turbo-generators for the lighting system, of which there are one 2250 kw, one 1000 kw and one 500 kw, are similarly connected to the 2300-volt main bus. The single-phase Allentown lighting and three-phase local motor circuits are supplied directly from this bus through remote-control, solenoid-operated oil switches in independent brick compartments. The lighting transmission lines for Bethlehem and Slatington are supplied through 23,000-13,200-volt, three-phase step-up transformers, delta-connected with induction regulators in the more important lines. All of the electrical equipment is of the General Electric Company make.

The arc lighting is supplied by 125-light, 9.6-amp Brush arc machines connected in pairs to three-phase, 60-cycle synchronous motors operated from the 2300-volt, 60-cycle bus. The 600-volt metallic motor circuit in Allentown is supplied from a rotary converter operating from the same bus through step-down transformers, a tie connection being provided between the direct-current bus and the railway buses in the local substation, which is situated in the same building, provision being made for starting this rotary from either end. The substations are all operated at 13,200 volts with delta-connected transformers. The railway system is operated on a twenty-hour schedule, the metallic circuit rotary which operates from the 60-cycle system being cut on to the railway feeders during the four-hour shutdown of the 25-cycle system, thus providing for emergency operation and specials. This permits repairs throughout the system without interruption in any of the services, duplicate lighting lines being provided as above noted wherever the continuous lighting service is required.

The officers of the company are as follows: Mr. R. P. Stevens, president and general manager; Mr. John C. Dawson, vice-president; Mr. Charles N. Wagner, secretary-treasurer, and Mr. C. M. Walter, auditor. The station and system were designed and erected by the Scofield Engineering Company, Philadelphia, Pa. The additional equipment mentioned is being installed under the engineering supervision of Messrs. Ford, Bacon & Davis, New York City.

AN EXPERIMENTAL DETERMINATION OF THE STRENGTH OF FULL-SIZED TELEPHONF POLES.

BY LAURENCE S. WINCHESTER.

A SERIES of experiments upon the strength, the deflection and the characteristics of failure of some full-sized cedar and chestnut telephone poles, as they are usually set in the ground, was conducted by the author last spring. These experiments were carried out in connection with the author's graduate work at the Massachusetts Institute of Technology and under the directions of Professors Jackson and Pender, of the electrical engineering department of that institution.

APPARATUS AND METHOD.

One end of a steel cable was attached to a pole by means of an eyebolt which passed through the pole. Into the other end of this cable was linked the hook of the load chain of a Harrington 3-ton duplex-chain hoist and the other hook of this hoist was slipped into one end of the large spring dynamometer which was used to measure the load. The other end of this dynamometer was then connected to an anchor pole by means of a short piece of the cable. The dynamometer was mounted on a dinkey to facilitate its removal from the field between the experiments. However, during the experiments it was rigidly blocked into a horizontal position. The deflection of the point where the load was applied, the movement of the butt, and any torsional movements were obtained by means of transit readings. This transit might have been read to less than a minute, but as each minute corresponded to approximately ¼ in. movement at the pole greater accuracy was needless. No torsional effects were noticed or expected on account of the manner in which the pole was loaded.

These experiments were conducted on a field just outside the Tech Field at Brookline, Mass. This field was originally a knoll, a part of which had been dug away for the sand and gravel available. In some places this digging had been carried to depths considerably below the present level and filled in with rubbish and loam. However, most of the soil consisted of the original sandy gravel. That portion of the knoll which had not been dug away had an elevation of about 6 ft. above where the poles were erected and, therefore, it formed an excellent position for the anchor pole, which consisted of an old pole set 7 ft. into the ground and projecting 4 ft. above it. Just ahead of this pole a trench was dug and a 7-ft. length of the same pole was laid in it and against the anchor in order to obtain a greater bearing surface. The dynamometer had been calibrated in the rope-testing machine at the Massachusetts Institute of Technology by applying a horizontal load, and, therefore, in the position in which it was to be used. The horizontal load may be taken as the total force acting on the pole without introducing an error of more than 1 per cent when the column effects and the like are taken into account. This, moreover, was negligible as compared with the accuracy of the dynamometer itself, which was about 3 per cent. The possibility of neglecting this vertical component was due to the long cable used and the elevation of the anchor, as will be readily appreciated after an examination of Fig. 1, where the relative positions of the various pieces of apparatus at both 1000 lb. and 1500 lb. load are represented to scale. The conditions shown in Fig. 1 were found to hold when the load was approximately 1000 lb. at the dynamometer. The point *A* moves over toward the right as the load increases until the cable becomes practically a straight line at 1500 lb. load as indicated by the dotted line.

HISTORY OF THE POLES.

In all, twelve white cedar poles from Maine and twelve chestnut poles from Connecticut were tested. The cedar poles were very green and were cut, as nearly as was ascertainable, about five months previous to the tests. The sap was still in them and the bark was left on. According to the results of some tests which Mr. Henry Grinnell published in the *Electrical Review*, New York, of Aug. 17, 1907, these should have had about 30 per cent moisture in them at that time. The chestnut poles were called virgin timber and had been held in a storage yard in Boston for about a year. These poles were, therefore, very dry and well seasoned. The bark was left on these poles also, only enough of it being removed to get the necessary measurements and to make the climbing sufficiently safe. Some worms had got under the bark of the chestnut poles, but they had not done any noticeable damage.

TABLE I.—SUMMARY OF THE RESULTS.

	White Cedar	Chestnut
Modulus of Rupture.	Pounds per Square Inch.	
Average	4,000	6,600
Maximum	5,600	9,780
Minimum	3,200	4,500
Modulus of Elasticity.	Inch Units	
Average	427,000	710,000
Maximum	974,000	1,260,000
Minimum	239,000	374,000
Position of Fracture.	Inches Above the Ground.	
Average	30	15
Maximum	115	70
Minimum	0	0

DESCRIPTION OF THE EXPERIMENTS.

The first ten poles and the anchor pole were set the day before Christmas. At that time there were 5 in. of frost in the ground. One of these poles was broken on Feb. 25 and the remaining nine were tested on March 17, 18 and 19. On March 22 and 23 ten more poles were erected and two of the first lot, Nos. 7 and 8, which had pulled out instead of breaking, were reset, poles Nos. 17 and 18 being set in concrete. This second lot of poles was tested on March 31 and April 1 and 2. On April 12 and 13 the four unused poles remaining and five from the second lot which had pulled out of the ground were set, two of these also being set in concrete. These poles were broken on April 28 and 29.

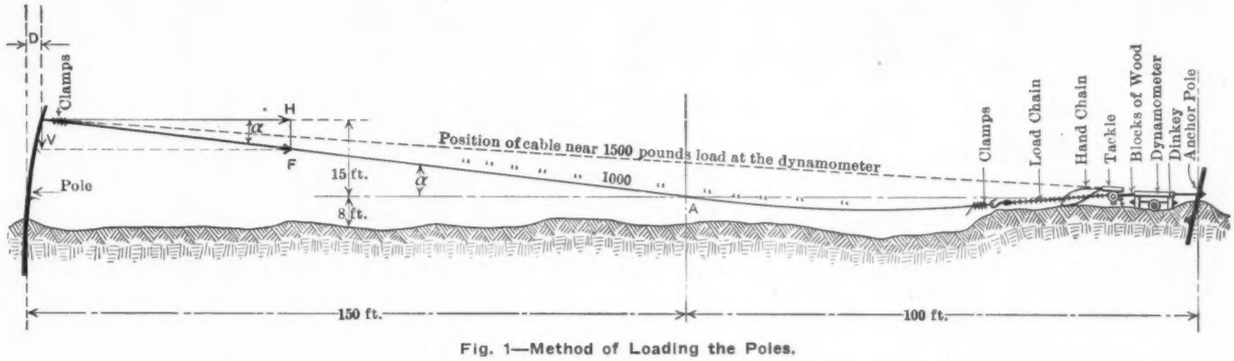


Fig. 1—Method of Loading the Poles.

None of the first ten poles were keyed at either the top or the bottom of the butt, but they were set at least 5 ft. deep. Most of the remaining poles were keyed, but it is very doubtful if this added anything to the strength of the setting unless very large rocks were used. Those poles which were set in

TABLE II.—CHESTNUT POLES.

Pole Number.	Maximum Load, Pounds.	Modulus of Rupture, Pounds per Square Inch.	Position of Rupture, Inches Above Ground.	Maximum Theoretical Stress, Pounds per Square Inch.	Position of Maximum Stress, Inches Above Ground.	Deflection, Inches.[1]	Modulus of Elasticity, Inch Units.[1]	Remarks.[2]
1	1,590	6,100	70	6,750	0	60.0	595,000	B
2	1,785	7,100	0	7,100	0	38.8	950,000	B
7	1,765	Pulled out		7,700	0	44.3	811,000	E
8	2,125	Pulled out		5,650	0	32.6	606,000	E
10	2,555	7,900	0	8,000	—	47.1	605,000	F
11	2,730	6,620	0	6,620	0	34.0	635,000	F
13	2,460	6,570	0	6,570	0	32.3	682,000	F
14	2,045	9,780	0	9,780	0	49.1	978,000	(7) C
15	1,830	5,170	24	5,200	0	66.2	374,000	(8) C
17	2,200	Pulled out		6,400	0	21.8	1,260,000	F
18	2,270	Pulled out		5,040	0	35.3	512,000	F
20	3,200	Pulled out		7,820	0	31.6	669,000	E
34	2,460	5,780	37	6,000	0	39.8	520,000	(20) F
35	2,450	5,230	0	5,230	0	29.6	553,000	(18) C
36	1,540	4,500	0	4,500	0	55.8	392,000	(17) F[3]
37	3,240	8,600	12	8,600	0	18.6	1,180,000	B
38	1,880	5,800	36	5,850	0	36.3	755,000	B
Average		6,600	15	6,680	0		710,000	
Maximum		9,780	70	9,780	0		1,260,000	
Minimum		4,500	0	4,500	0		374,000	

Other published results:

	Modulus of Rupture, Pounds per Square Inch.	Modulus of Elasticity, Inch Units.*
Rankine	10,660	
Standard Handbook	5,000	1,000,000
Forest Service Bulletin Number 70.	6,200 (green lumber)	1,064,000
Forest Service Bulletin Number 70.	11,300 (kiln-dried)	1,439,000
Foster's Handbook	5,950 to 12,870	

[1] At 1110 pounds load.
[2] The letters indicate the movement of butt at the ground: A=0 in. to 2 in.; B=2 in. to 4 in.; C=4 in. to 6 in.; D=6 in. to 8 in.; E=8 in. to 10 in.; F=10 in. to 15 in.; G=15 in. to 20 in.; H=over 20 in.
[3] Deflection and modulus taken at 870 lbs. load instead of 1110 lbs.

TABLE III.—CEDAR POLES.

Pole Number.	Maximum Load, Pounds.	Modulus of Rupture, Pounds per Square Inch.	Position of Rupture, Inches Above Ground.	Maximum Theoretical Stress, Pounds per Square Inch.	Position of Maximum Stress, Inches Above Ground.	Deflection, Inches.[1]	Modulus of Elasticity, Inch Units.[1]	Remarks.[2]
3	1,830	3,500	0	6,000	115	27.3	974,000	B
4	1,495	3,600	0	3,700	61	43.1	495,000	F
5	1,590	3,800	12	4,100	74	51.3	449,000	B
6	1,830	5,600	14	5,900	0	45.1	600,000	E
9	2,350	4,300	0	4,300	0	31.6	399,000	E
12	1,977	4,520	50	4,780	137	59.9	379,000	C
16	1,235	3,430	0	3,510	62	103.5	265,000	H
19	2,075	4,320	0	4,330	15	63.9	283,000	E
21	2,025	Pulled out		3,860	58	44.6	393,000	E
22	1,880	Pulled out		4,010	104	34.6	309,000	C
31	2,175	4,010	78	4,010	74	27.5	554,000	B
32	2,095	3,780	115	3,890	55	45.0	391,000	D
33	1,340	3,200	66	3,330	90	89.5	248,000	B
39	2,650	Pulled out		3,600	98	41.1	239,000	(22) H
Average		4,000	30	4,350	65		427,000	
Maximum		5,600	115	5,900	137		970,000	
Minimum		3,200	0	3,330	0		239,000	

Other published results:

	Modulus of Rupture, Pounds per Square Inch.	Modulus of Elasticity, Inch Units.[1]
Rankine	7,400	
Standard Handbook	5,000	700,000
American Telephone & Telegraph Company	4,000	
Foster's Handbook	6,310 to 9,530	

[1] At 1110 pounds load.
[2] The letters indicate the movement of butt at the ground: A=0 in. to 2 in.; B=2 in. to 4 in.; C=4 in. to 6 in.; D=6 in. to 8 in.; E=8 in. to 10 in.; F=10 in. to 15 in.; G=15 in. to 20 in.; H=over 20 in.

concrete only had a ring of it at the top and the bottom of the butt, because here is where the greatest bearing pressure comes, while somewhere in the middle the bearing pressure is zero. This ring of concrete was made about 1 ft. thick and 1½ ft. wide. In order to increase the rate of application of the load and give the poles less time to give in the ground some of the transit readings were omitted. The poles

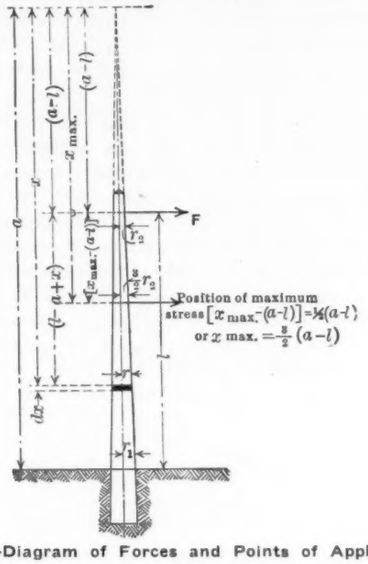


Fig. 2—Diagram of Forces and Points of Application.

were also set with a slight lean backward so that they would be more nearly vertical at the breaking loads and there would be less tendency to pull out.

material that the individual results do not vary more from the average. Then, too, the modulus of rupture is a fictitious quantity because it assumes that Hooke's law holds up to the time of breaking. The values given by other authorities were obtained in the majority of cases from small specimens and under artificial conditions. These factors alone are sufficient to account for the higher values and show the unreliability of such data so far as its value in actual construction is concerned.

The way that the cedar poles failed is well shown in Fig. 4, and Fig. 5 shows the characteristic failure of a chestnut pole.

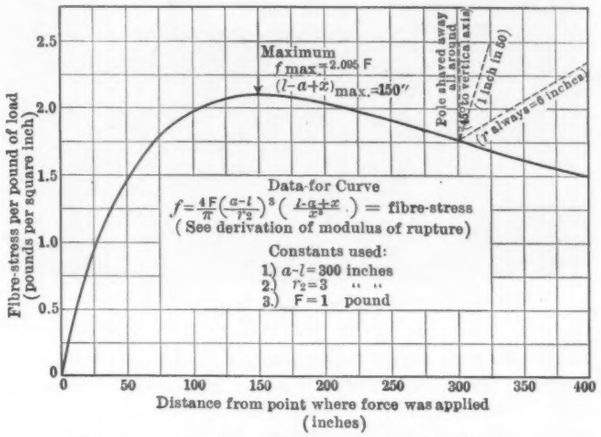


Fig. 3—Variation of Fiber Stress with Distance.

Many a chestnut pole still supported a part of the load after the first failure, but the cedar poles usually snapped right off short. This characteristic is a point decidedly in favor of the

TABLE IV.—DIMENSIONS AND OTHER DATA.

Pole Number.	Wood.	Total Length of Pole, Feet.	Length of Butt in Ground, Feet.	Distance from Ground to Point of Application of Force, Inches.	Circumference at Ground, Inches.	Circumference at Point of Application of Force, Inches.	Circumference at the Top, Inches.	Kind of Setting.[1]	Same Pole as Number.
1	Ch.	30.5	5.5	273	27.25	20.60	19.50	G	
2	Ch.	30.0	5.5	276	28.00	20.75	20.00	R	
3	Ce.	29.3	5.3	275	37.25	19.50	19.25	S	
4	Ce.	29.5	5.0	278	33.25	21.25	21.00	S	
5	Ce.	30.3	5.3	278	32.75	19.50	18.50	S	
6	Ce.	30.4	5.3	272	29.90	20.50	17.00	L	
7	Ch.	31.4	5.3	278	27.25	21.75	18.25	L&S	
8	Ch.	30.0	4.6	267	31.75	22.25	21.25	L&S	
9	Ce.	30.3	5.0	275	36.60	24.75	24.50	G	
10	Ch.	30.3	5.0	273	30.40	18.75	19.00	G	
11	Ch.	31.2	5.0	303	34.50	24.00	24.50	G	
12	Ce.	30.2	5.0	290	35.00	18.50	17.95	R	
13	Ch.	30.3	5.25	289	32.50	23.60	23.00	S	
14	Ch.	31.4	5.0	306	27.25	21.75	18.25	S	7
15	Ch.	30.0	5.0	288	31.75	22.25	21.25	S	8
16	Ce.	29.9	5.0	287	32.00	19.50	19.00	L	
17	Ch.	31.00	5.0	300	32.00	22.25	22.50	C_1	
18	Ch.	31.0	5.1	300	35.00	25.75	23.00	C_1	
19	Ce.	29.75	4.2	295	35.50	23.25	21.75	G	
20	Ch.	31.3	5.0	304	34.00	25.00	23.75	GR	
21	Ce.	31.6	4.4	316	38.00	23.50	23.00	G	
22	Ce.	29.75	4.8	287	41.5	23.25	22.50	FS	
31	Ce.	30.2	5.6	284	37.00	22.00	21.00	S	
32	Ce.	31.6	5.6	313	38.00	23.50	23.00	S	21
33	Ce.	29.7	5.5	279	33.50	19.25	18.25	L	
34	Ch.	31.4	5.1	302	34.00	25.00	23.75	GR	20
35	Ch.	31.0	5.9	290	35.00	25.75	23.00	G	18
36	Ch.	31.0	4.8	302	32.00	22.25	22.50	L	17
37	Ch.	31.0	5.2	300	33.0	25.25	24.00	C_2	
38	Ch.	30.5	5.25	294	31.00	23.00	21.25	C_2	
39	Ce.	29.9	5.4	281	41.50	23.25	22.50	S	22

[1] Kind of setting: G=gravel with no rocks; GR=gravel with small rocks; R=many small round rocks; S=sand with small rocks; FS=very fine sand with no rocks; L=loam; C_1=first lot of concrete (this lot was not properly mixed); C_2=second lot of concrete (this lot was properly mixed).

RESULTS.

The results of these experiments are seen in the accompanying tables. It is rather surprising when one really stops to think how far wood is from being a homogeneous chestnut poles and is due to a greater freedom from small knots and a straighter and tougher grain than the cedar has. Often the grain of the cedar will spiral around the pole.

The large variation of the deflections of the individual

poles and the corresponding variation of the modulus of elasticity shows the effects of the various settings. The deflection of the top of the pole due to a small give of the butt in the ground was quite large, and still there was no practical way of eliminating it or allowing for it. (See Fig. 6.) Greater speed in applying the load would have helped. Concreting

Fig. 4—Cedar Pole.

would also have helped, but the effect of the normal soil was desired. This was rather a rigorous test of the various settings. Fine sand and loam were found to be very weak. Even keying was but little help unless the keys were enormous. Gravelly soil with small rocks was the best. Where the cement was properly mixed and used in rings about 1 ft. thick it held the poles as firmly as if in a vise. The torsional readings were omitted after the first few experiments, but while this just about doubled the speed it was not sufficient to eliminate the give of the butt in the ground. The values for the modulus of elasticity are undoubtedly much too low on this account.

In the scanty literature on this subject the article of greatest interest is a paper read by Mr. Wade before the Institution of Electrical Engineers describing some experiments which he carried out. He used red fir and therefore the numerical results are not particularly interesting at this time. The tests were principally upon "A" poles held in a horizontal position. His greatest difficulty came in devising a suitable manner of joining the poles at the top. In actual practice, however, considerable trouble would be experienced in obtaining suitable anchorages. These "A" poles showed four times the strength across the line and twice the strength along the line that single poles had. This is a very desirable property and is now being introduced into steel-tower construction. With the rapidly decreasing supply of large-sized poles that now confronts the industry it soon will be necessary to devise some means of employing lighter construction or using a substitute for wood.

DERIVATION OF FORMULAS.

The assumptions which it is usually customary to make in dealing with the properties of materials are given in Lanza's "Applied Mechanics," page 268, as:

(1) A plane cross-section remains a plane after bending takes place,

(2) Hooke's law must hold, and

(3) The position of the neutral axis remains unchanged.

On these three assumptions the common theory of beams is based, and therefore the fundamental formula for the fiber-stress is directly applicable. This formula is:

$$f = \frac{My}{I}$$

where

f = the fiber-stress in pounds per square inch.

M = the bending moment in inch-pounds,

y = the distance of the fiber under consideration from the neutral axis in inches, and

I = the moment of inertia of the section taken about the neutral axis and expressed in inch-units.

Now y and I are both functions of r, the radius of the section in question, assuming a circular section, of course, i. e.:

$$y = r \text{ and } I = \frac{\pi r^4}{4} \text{ or } \frac{y}{I} = \frac{4}{\pi r^3}$$

Then let $(l - a + x)$, whose significance will be shown later, be the distance from the point where the force is applied to the section in question, when

$$M = F(l - a + x) \text{ and } f = \frac{4F(l - a + x)}{\pi r^3}$$

In Bulletin No. 53 of the Bureau of Forestry, entitled "Chestnut in Southern Maryland," the author found a table giving the diameters of a large number of growing trees of different ages and at different heights above the ground, from which he made a plot and showed that the nearest simple geometrical shape for the poles was really a truncated cone. Then if a is the total length of the complete cone of which the pole is a fustrum, and if l is the distance from the point where the force is applied to the ground, then if x is the distance from the apex of the cone to the section under consideration, $l - a + x$ is the distance from the point where the force is applied to that section, and (see Fig. 2) these equations follow:

$$\frac{r}{r_2} = \frac{x}{a - l} \text{ and } \frac{r_1}{r_2} = \frac{a}{a - l} \text{ or } a - l = \frac{r_2 l}{r_1 - r_2}$$

$$\therefore f = \frac{4F(a - l)^3 (l - a + x)}{\pi r_2^2 x^3}$$

where f is now expressed in terms of the one variable x. The fictitious distance $a - l$ may now be eliminated, but this substitution is not especially desirable, as the formula is of little use in its present form. What is desired is the maximum value of f, and this is readily found after differentiating the above with respect to x to find the condition for a maximum. This condition is found to be either:

$$x \text{ (max.)} = 1.5(a - l) \text{ or } r \text{ (max.)} = 1.5 r_2$$

$$\therefore f \text{ (max.)} = \frac{4F[l - a + 1.5(a - l)]}{\pi (1.5 r_2)^3} = \frac{16F(a - l)}{27 \pi r_2^3}$$

$$= 0.1887 \frac{Fl}{(r_1 - r_2) r_2^3}$$

Fig. 5—Chestnut Pole.

Fig. 6—Give of Pole in Ground.

and since this maximum occurs at the point $x = 1.5(a - l)$ the distance from this point to the ground is $\frac{(2r_1 - 3r_2)l}{2(r_1 - r_2)}$ inches. While this work is correct mathematically the problem is actually limited by the condition that the formula for

the fiber-stress applies only between the ground and the point where the force is applied. Therefore, if $r_1 \gtreqless 1.5\, r_2$ the position of the maximum stress comes at the ground level and that maximum stress is $f\,(\text{max.}) = \frac{4Fl}{\pi r_1^3}$. In Fig. 3 a plot of the variation of the fiber-stress with the distance from the point where the force is applied is shown. The condition that $r_3 \gtreqless 1.5\, r_2$ simply means that the pole is set in the ground up to the point where $l - a + x = 150$ or further respectively. Thus we see why the maximum stress comes at the ground when $r_1 \lesseqgtr 1.5\, r_2$. The dotted lines in this figure at the point where $l - a + x = 300$ show how very rapidly the fiber-stress would increase if the pole was to be shaved away, beginning at this point and going downward at the rates indicated, or as in actual practice often results from decay at the ground line.

The formula for the deflection of the point of application of the force is subject to the same assumptions as the formulas for the fiber-stress. The fundamental equation in this case is:

$$D = \int\int \frac{M}{EI} dx\, dx$$

where E = modulus of elasticity (assumed constant).

We already had $M = F\,(l - a + x)$ and $I = \frac{\pi r^4}{4}$

$$\therefore D = \int\int \frac{4F\,(l - a + x)}{E \pi r^4} dx\, dx$$

but $$r = \frac{r_2 x}{a - l}$$

and $$a - l = \frac{r_2 l}{r_1 - r_2}$$

whence

$$D = \frac{4F\,(a-l)^4}{\pi E r_2^4} \int\int \frac{(l - a + x)}{x^4} dx\, dx$$

Now

$$\int\int \frac{(l - a + x)}{x^4} dx\, dx = \int \left[\frac{l-a}{-3x^3} + \frac{1}{-2x^2} + c_1\right] dx$$

$$= \left[\frac{l-a}{6x^3} + \frac{1}{2x} + c_1 x + c_2\right]$$

The slope is represented by $\frac{d}{dx}(D)$ and is zero at the point $x = a$. Whence we have the condition:

$$\frac{l-a}{-3a^3} + \frac{1}{-2a^2} + c_1 = 0 \text{ or } c_1 = \frac{2l + a}{6a^3}$$

The deflection is likewise zero at this same point $x = a$ and

$$\therefore \left[\frac{l-a}{6a^3} + \frac{1}{2a} + \frac{2l+a}{6a^2} + c_2\right] = 0$$

$$6a^3 c_2 = a - l - 2l - a - 3a \text{ or } c_2 = -\frac{(a+l)}{2a^2}$$

and

$$D = \frac{4F}{\pi E}\left[\frac{a-l}{r_2}\right]^4 \left[\frac{l-a}{6x^2} + \frac{1}{2x} + \frac{(2l+a)\,x}{6a^3} - \frac{(a+l)}{2a^2}\right]$$

What is really desired is the deflection of the point where the force is applied or where $x = a - l$.

$$\therefore D\,(\text{max.}) = D\,(\text{top}) = \frac{4F}{\pi E}\left(\frac{a-l}{r_2}\right)^4 \left[\frac{-(a-l)}{6(a-l)^2} + \frac{1}{2(a-l)} + \frac{(2l+a)(a-l)}{6a^3} - \frac{(a+l)}{2a^2}\right]$$

$$= \frac{4F}{3\pi E} \frac{l^4}{(r_1 - r_2)^4} \left[\frac{1}{a-l} - \frac{(a^2 + al + l^2)}{a^3}\right]$$

$$= \frac{4F}{3\pi E} \frac{l^4}{(r_1 - r_2)^4} \frac{1}{(a-l)\,a^3} = 0.424\, \frac{Fl^3}{E r_1^3 r_2}$$

The following formulas, which apply to a pole subjected to a single horizontal load, were used to calculate these results from the data obtained from the tests:

Modulus of Rupture:

(1) When $r_1 \geqq 1.5\, r_2$, $f\,(\text{max.}) = 0.1887 \frac{F\,(\text{max.})\, l}{(r_1 - r_2)\, r_2^3}$

(2) When $r_1 \lesseqgtr 1.5\, r_2$, $f\,(\text{max.}) = 1.273 \frac{F\,(\text{max.})\, l}{r_1^3}$

Modulus of Elasticity:

$$E = 0.424\, \frac{Fl^3}{D r_1^3 r_2},$$

where

r_1 = radius of the pole at the ground expressed in inches;

r_2 = radius of the pole at the point where the force is applied expressed in inches;

l = distance from the ground to the point where the force is applied expressed in inches;

$f\,(\text{max.})$ = modulus of rupture, or the breaking strength expressed in pounds per square inch;

D = deflection of the point where the force is applied expressed in inches;

E = modulus of elasticity expressed in inch-units, and

F = horizontal force or load expressed in pounds.

ARC-LAMP ELECTRODES.

Their Composition, Method of Manufacture and Impregnation for Various Classes of Service.

BY A. MAHLKE.

THE development of arc-lamp electrodes has taken place chiefly in Germany, from which country more than 10,000,000 lb. of carbon electrodes are exported annually. Much of the product finds its way into the United States, although the electrodes manufactured in this country have improved very much during the last few years. Since the raw material necessary for the manufacture of arc-lamp electrodes is found in abundance in this country, and inasmuch as it is also very much cheaper here than abroad, it may be predicted confidently that in the near future all the carbon electrodes burned in this country will also be manufactured here.

If one does not take into account the usual homogeneous carbon electrodes for direct-current inclosed arc lamps, which are expected to disappear in the near future, arc-lamp electrodes may be said to consist of a shell made of different kinds of carbon material and a core containing principally metallic salts for supporting the arc. The shell is intended as a conductor of electricity, the core usually being a bad conductor and sometimes even an insulator when it is cold; but when the core is raised to a high temperature it becomes conducting. For this reason at the hot end of the electrode the current has to jump from the shell to the core, forming the arc as indicated in Fig. 1.

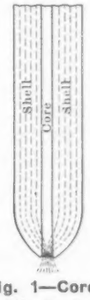


Fig. 1—Cored Electrode.

It is of the greatest importance, if steadiness of light is desired, that the arc be not fed from any point other than the end of the core. If there is any dirt in the shell which could support the arc the latter would jump to it from the core and there would be a variation in the light and in the voltage of the lamp. Therefore, it is necessary to exercise the greatest cleanliness in making arc-lamp carbon electrodes, although one would not be so impressed with the necessity for cleanliness from cursory inspection of a carbon factory. Especially in working up the raw materials for the carbon shells must great care be exercised to keep them pure. This is somewhat difficult, because these materials have to undergo a long sries of processes. The material must first be ground very fine; then

the powder has to be mixed with some binder, and the resulting mixture must be stamped and pressed into the shape of the carbon shells. These carbon shells, being yet in a green state, are next packed into a furnace and baked at a high temperature; then they are shaped into various forms, and finally provided with a core.

COMPOSITION OF SHELL.

Of the raw materials for arc-lamp electrode manufacture lampblack is the most important. The lampblack used for electrodes is made by burning suitable derivatives of tar in a pan, to which no more air is admitted than is necessary for supporting the flame. Usually for this purpose tar oils are employed which have been distilled from tar at temperatures between 240 deg. C. and 270 deg. C. The dense vapors arising from the pan are conducted through a series of chambers, where the lampblack is deposited on the walls and ceilings. After the run is finished the lampblack is collected from the chambers. But there are different kinds of lampblack in the different chambers, which must be kept separate, the various kinds being of lower or higher weight, according to their fineness or to the amount of water and oil contained in them.

Lampblack for arc-lamp electrodes should not contain more than 0.5 per cent of water and oil. If this amount is exceeded the excess has to be evaporated by heating the lampblack. The limit for ash which the lampblack may contain is much lower. For first-class electrodes lampblack containing more than 0.02 per cent of ash cannot be used. In this country much lampblack is produced from natural gas. This lampblack is generally used for making printing ink and paints. Although it would be very valuable for making arc-lamp electrodes, the author does not know whether it has ever been tried for this purpose.

Tar is another material of great importance in the carbon industry. Usually coal tar is employed, but petroleum tar may also be used. The tar sold by the gas companies must be first cleaned if it is not supplied in a pure state. This cleansing is performed by filter presses, in which the tar is forced under a pressure of about 100 lb. per square inch through a filter cloth. For rendering the tar more viscous it is either heated or diluted with benzole. In this way the tar is separated from all solid particles contained in it. In Germany revolving separators are sometimes used to effect the same end.

The tar thus prepared should not contain more than 0.02 per cent of ash if it is to be used for making arc-lamp electrodes. But before being available for that purpose it has to be freed from water and from those components having a low boiling point. The evaporation of these is effected by heating the tar by steam coils for several hours in a vessel open to the air. The actual time will depend on the amount of tar to be treated. If the tar be kept at a temperature a little below the usual boiling point of water, it will be freed from nearly all the water, from the oils which volatilize at low temperatures and also from naphthaline, which condenses like snow around the vessel. After this operation the tar will contain less than 1 per cent of water. By being distilled up to 300 deg. C. about 20 per cent of volatile matter will pass off, and after being heated to red heat, when no more vapors are given off, there will be a solid residue of about 30 per cent of the original bulk. These figures may vary by several per cent for different kinds of tar.

Besides tar, pitch is also used as a binder in making carbon electrodes in this country. The pitch is made from tar, which is cleaned by forcing it through a filter press. By heating this tar much of its volatile matter is evaporated, so that it becomes solid on cooling. The temperature to which the tar is raised is about 300 deg. C., this value changing according to the degree of hardness which the pitch is to have. The melting point of the pitch varies from 40 deg. C. to 90 deg. C., depending on the kind of pitch, and the ash content is about 0.04 per cent, or a little higher than that of the pure tar.

While the materials described above are used only for first-class arc-lamp electrodes, lower-grade electrodes may be made partly out of retort coke or of petroleum coke. These materials, having a much better electric conductivity, are to be preferred by far to lampblack if they are obtainable in the same state of purity. In Europe retort and petroleum coke containing less than 0.25 per cent of ash can be produced, but in this country the percentage of ash contained in these materials is usually much higher.

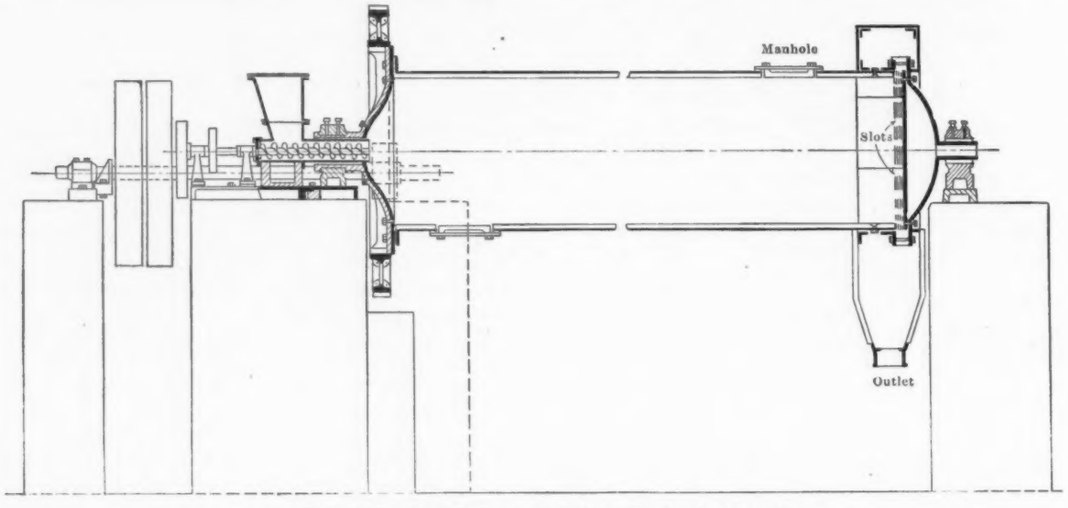


Fig. 2—Tubular Mill for Grinding Electrode Material.

PREPARATION OF MATERIALS.

The first step in making carbon electrodes after having prepared the materials is to mix lampblack and tar in suitable proportions, usually from 135 lb. to 138 lb. of tar to 100 lb. of lampblack. The mixture is molded by hydraulic presses into cubical or cylindrical plugs nearly 1 ft. in diameter, which are then baked in a furnace at a temperature of at least 1000 deg. C. By raising this temperature to 1300 deg. C. or 1400 deg. C. better results are obtained. The plugs after having been cooled are crushed and ground to a fine powder or flour, which is called baked lampblack.

In factories where work has to be carried on for some time there is always a large amount of broken electrodes or carbon scrap. This scrap, when kept pure enough, after having been ground to a fine flour, is the best material for making new electrodes and can be used instead of the baked lampblack. Both kinds of carbon flour when used for first-class electrodes must be fine enough to pass through a 200-mesh sieve.

The grinding of these materials is done in different kinds of mills, such as conical iron mills, like coffee mills or stone mills, similar to corn mills; but the best machines for this purpose

are large tubular mills, like that shown in Fig. 2. In this grinder the cylindrical tube is about 25 ft. long and 5 ft. wide. It is revolved at the rate of from 25 r.p.m. to 30 r.p.m. by gearing. The cylinder is lined with soft wood and filled about one-third full with the material to be ground by means of the hopper arrangement shown at the left of the engraving. The grinding is performed

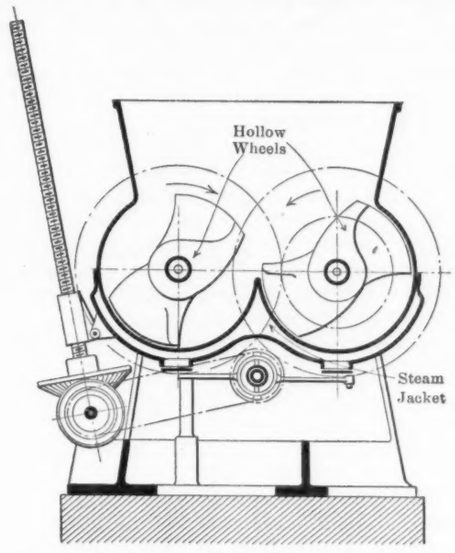


Fig. 3—Machine for Mixing Electrode Material.

by flint stones about the size of goose eggs, which are mixed with the material and grind the carbon between their surfaces as the cylinder revolves. Such material as may be ground by itself may be milled without such stones, but the process of grinding is in this case a little slower. After the mill has been used for some months the lining is renewed, and for that purpose manholes are provided in the cylinder.

A good mixture for first-class arc-lamp electrodes consists of 100 lb. of raw lampblack, 100 lb. of baked lampblack of 200-mesh made either of carbon scrap or of the plugs described above, 1 lb. boric acid and about 160 lb. of tar. The proportion of tar is changed according to the thickness of the electrodes to be made. When making thin electrodes less tar is used.

For mixing these materials a machine like that shown in Fig. 3 is used. Two hollow steam-heated wheels provided with wings revolve in opposite directions in a receptacle fitted with a steam jacket at the bottom. The dry powders are first poured in and mixed, and afterward the tar is added, the wheels and receptacle being heated all the while by steam. After the lapse of an hour's operation the mixture is dumped, the receptacle being tilted around the shaft beneath the steam jacket by the mechanism shown at the left of the engraving.

In this country another mixture containing no raw lampblack, but consisting of baked lampblack only and pitch, is often used. In order to make the mixture workable a suitable amount of tar oil is added. Electrodes made from this mixture can be baked in a horizontal position in the furnace, while those electrodes containing a larger amount of raw lampblack must be baked in a vertical position, as they crack when baked in a horizontal position.

A mixture for good coke electrodes is made up of 100 lb. of 100-mesh coke flour, 100 lb. coke-electrode scrap flour of the same fineness, 60 lb. 200-mesh baked lampblack, 40 lb. raw lampblack, 3 lb. boric acid and about 155 lb. of tar.

Before the mixture can be shaped into final form it must be kneaded, and this operation is performed either by rolling mills or by pan rolls. Fig. 4 shows one of the latter. Two rolls about 5 ft. in diameter and weighing about 2000 lb. each turn in a pan containing the mixture to be kneaded. Two pairs of boards or scrapers keep the mixture in the path of the turning rolls. Most of the pan rolls used in this country are constructed so that the pan turns while the rolls and the boards remain stationary. This construction is not so effective because the pan yields somewhat, so that there is not the same pressure brought on the material to be kneaded as there is in the construction described above. After being well kneaded the mixture is placed in cylinders suited for a hydraulic press, in which it is shaped into carbon shells. A shovelful of the mixed material is put into a cylindrical mold and rammed down by a tamping press. Then another shovelful of the material is added and rammed down, and so on until the mold is filled and a homogeneous, solid cylinder of the mixed material obtained. The cylinders are then placed in a hydraulic press like that shown in Fig. 5.

MANUFACTURE OF ELECTRODES.

The press consists of two parts *A* and *B* connected together by two steel shafts. The part *A* contains the nozzle *n* out of which the electrodes are forced, while the part *B* contains the hydraulic cylinder and the piston *k*. Fastened to the piston *k* is the piece *g* bearing on its lower end the toothed segment *s*. Connected to the piece *g* is a hollow pressure cylinder *c* supported by the piece *d* sliding on the lower shaft. The pressure cylinder adjoins the piece bearing the dented wheel *z* meshing in the toothed segment *s*, by means of which the hollow pressure cylinder can be turned out of its position around the lower shaft so that it is open at its left side for the reception of the carbon cylinders. The lever *h* performs this movement and the counterbalance makes it easier to place the hollow pressure cylinder in its former position.

The operations of the press are regulated by the toothed rod *z'* having stops *y* and *y'* which move the part *g* to the right or left, while its teeth engage the little cogwheel *b*, moving by a toothed segment the valve *v*. Above this valve a pressure gage is placed. The cogwheel *b* can also be turned by the handwheel *r'*. When by these means the valve *v* is opened the material contained in *c* is forced through the hollow pipe *i*, which is heated by a steam jacket, and out of the nozzle *n* as a continuous rod.

When hollow electrodes are desired instead of the nipple *p* a mouthpiece like that shown in Fig. 6 is fixed on the end of the pipe *i*. By means of the ring *r* and three rods *s* the rod *d* is kept in the center of the orifice *m*, which is fitted with a transition cone *u* for decreasing slowly the cross-section of

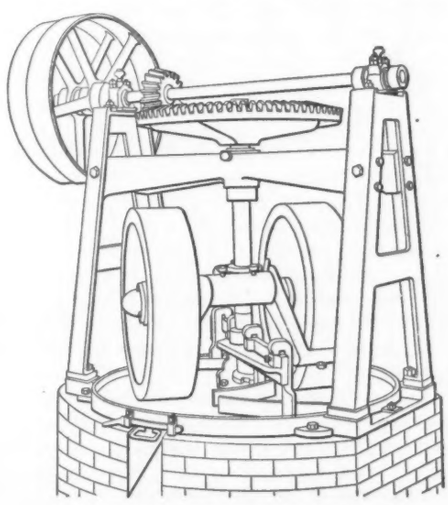


Fig. 4—Pan-Roll Kneading Machine.

the carbon material moving from right to left around the rod *d* and emerging from the orifice *m* as a continuous hollow cylinder with a hole corresponding to the end of the rod *d*.

The diameters of the orifice *m* and the rod *d* must be a little larger than the corresponding dimensions of the electrodes to be made so as to allow for shrinkage when baking in the furnace. The pressure necessary for making tar carbons is

about 1500 lb. to 1800 lb., and the temperature about 80 deg. C. For pitch carbons the pressure as well as the temperature is somewhat higher. When making the latter carbons it is usually necessary to heat the mouthpiece of the press by a gas flame, but this is not necessary in the case of tar carbons.

The carbon rod from the hydraulic press is cut by hand into pieces 4 ft. to 5 ft. in length and these pieces are bound together into hexagonal bundles about 10 in. in diameter. The bundles then lie in storage for some days before they are put into the furnace. When ready the bundles are put in a vertical position in saggers of the form shown in Fig. 7, closed by a cover. These saggers are usually made in the carbon factory itself with much care so that they may be used for a number of runs. The materials used for their manufacture are thirty parts kaolin and twenty parts of highly refractory clay mixed with fifty parts grog (scrap of broken saggers ground to a coarse flour). This is mixed with water, molded into shape and then allowed to dry by standing in the open air. When thoroughly dried the saggers are covered with a glazing material and baked in a furnace at a temperature of at least 1300 deg. C. A well-made sagger, if handled properly, can be used about fifteen times for baking electrodes.

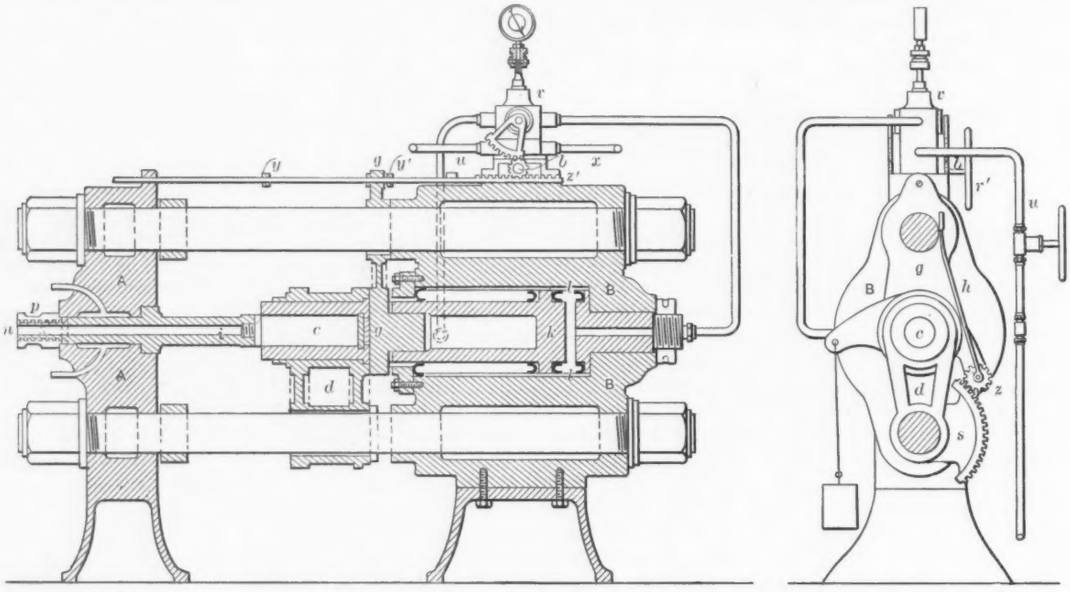


Fig. 5—Hydraulic Press for Making Electrodes.

Into these saggers the hexagonal carbon bundles are put, while the space between the bundles and the wall of the sagger is filled with a coarse coke product, which is also placed on top of the bundle to replenish the whole sagger. The cover is then fixed on top of the sagger by means of a clay paste.

FURNACES FOR BAKING ELECTRODES.

For economy and ease of baking all material at the same temperature ring furnaces are best suited. These furnaces, like similar brick furnaces, consist of a series of chambers or compartments, thirty-two being usually connected to a ring by flues so that the heat can pass through all chambers one after the other in continuous movement. Suitable dimensions of chambers are: Length, 9 ft.; width, 5 ft., and depth, 6 ft. to 7 ft.

By building the whole furnace below the level of the floor and making the depth of the chambers larger than the width, since only the heat radiated from the covers is lost, the heat losses are reduced as much as possible. The fire progresses daily in the series of chambers by four such compartments, so that the whole furnace takes about eight days to heat, after which time the fire is working again on the same chamber as at the beginning. The chambers ahead of the fire are heated by the combustion gases, which leave the furnace at the eighth or tenth chamber beyond the fire before going to the stack, when their temperature is about 200 deg. C. The air necessary for supporting the fire is conducted through the heated chambers which the fire has left, cooling these chambers and producing a very high temperature (1400 deg. C.) in the chambers under fire. Thus nearly all the heat produced in the furnace is used for its proper purpose and a very small part of it lost.

The fire progressing by four chambers a day, it is necessary to open four cooled chambers to take the electrodes out and to fill the chambers up again. In a furnace of the dimensions given above about 3000 kg (3 tons) of electrodes can be baked in twenty-four hours. If producer gas were employed in this furnace it would require nearly 1500 kg (3306 lb.) of fuel producing 7000 calories per kilogram (12,600 lb.-Fahr. units per pound). In many places natural gas can be burned in the ring furnaces, making the operation of the furnace much easier, because natural gas has a greater heating power and does not clog up the flues in the furnace with tar vapors, which in producer gas are contained in so large an amount that after some months' working the flues of the furnace are closed by the deposits of the gas, necessitating the shutting down of the furnace and the cleaning of the flues. The draft in the furnace should be kept as low as possible in order to prevent the cracking of the hot saggers. The author has found a draft of 2 mm water pressure in the chambers of the furnace sufficient.

The baked electrodes are now cut to proper length for arc lamps and assorted, the crooked and cracked electrodes being rejected and scrapped. After that one end of the carbon is pointed, while the other is finished off smooth. The electrodes thus prepared can be cored. This operation is performed by little presses consisting of a hollow cylinder into which the coring material is to be filled. The latter is forced out of a little hole with which the hollow cylinder is provided and against which one end of the carbon to be cored is held.

The operation of coring can be done either by automatic machines utilizing a weight on a piston or by hydraulic pressure, or it may be performed by hand, the piston in the hollow cylinder containing the coring material being moved by a screw and hand-wheel. Short electrodes having thick shells can be cored best by automatic machines, while longer electrodes with thin shells must be cored by hand, it being easier by this means to regulate or proportion the pressure to the strength of the shell.

COMPOSITION OF CORING MATERIALS

The coring material for common arc-lamp electrodes burnt in open-arc lamps, projector lamps and other similar lamps is made of two parts of baked lampblack and one part of potas-

sium silicate. The baked lampblack is of 200 mesh and the potassium silicate is applied as a solution made with steam and hot water and has a density of 24 deg. Baumé for direct-current electrodes and a little lower density usually for electrodes for alternating-current lamps. The potassium silicate acts as a binder for the material of the core, and the potassium, when burnt in the arc, reduces its counter e.m.f. An arc consuming carbon alone requires a much higher voltage, so that an arc at the lower voltage for which the lamp is regulated can exist only at the end of the core. Thus the arc is maintained at that place so long as there are no impurities in the shells which

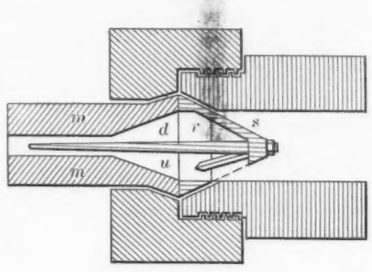


Fig. 6—Mouthpiece for Hollow Electrodes.

Fig. 7—Sagger.

could reduce the voltage of the arc, like the potassium of the core.

The coring mixture for flaming-arc lamp electrodes is more complicated, containing as it does metallic salts for feeding the arc. When Bremer first introduced this kind of lamp the same sort of electrodes in which the core had a diameter of about one-third of the shell were used for the positive and negative as well as for the alternating-current lamps. At the author's proposal different kinds of electrodes have been made for these different purposes. In direct-current lamps the positive electrodes have a core with a diameter about half that of the shell, while in the negative electrodes and those used for alternating-current lamps the diameter of the core is about one-third that of the shell. The reason for this construction is because in operation particles of the positive electrode are carried over and deposited on the negative electrode. The positve electrode, therefore, must contain as much metallic salts as possible, while the negative electrode usually contains no such salts and is made in the same manner as common carbon electrodes, its core consisting of lampblack and potassium silicate only. But for very many lamps it is usually best to provide the negative electrodes with metallic salts also.

The composition for the core of positive electrodes for direct-current lamps, as well as the material for the electrodes of alternating-current lamps, consists of 40 per cent of baked lampblack and 60 per cent of metallic salts. The metallic salts

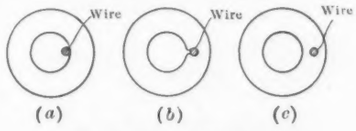


Fig. 5—Wired Electrodes.

for electrodes giving a yellow flame are calcium fluoride and calcium phosphate, which latter must be calcined. For alternating-current lamps less phosphate is used than for direct-current lamps and the phosphate may even be omitted. A German firm adds to the calcium salts about 10 per cent of cerium salts, which makes the yellow light more whitish.

The cerium salts, which are a by-product of the Welsbach mantle industry, are the principal ingredients of the electrodes giving a white light. Usually cerium fluoride forms two-thirds of the core mixture contained in these electrodes, the other third being mostly calcium salts.

The powders out of which the core is to be made must be sifted very well and be mixed very carefully, else the core of the finished electrode will have white spots which cause disturbances of the light when burned in the flame. As a binding material potassium silicate, which is made alkaline by adding some potassium hydroxide, is used. In certain flaming-arc electrodes potassium silicate is not used as a binding material, but some organic substance, like glucose. In such a case there is added to the core a small amount of potassium salts or boric acid. These materials may be necessary for starting the arc because metallic salts like calcium and cerium fluoride have high melting and boiling points.

When the electrodes have been cored they must be dried at a temperature of about 150 deg. C. This must be done very

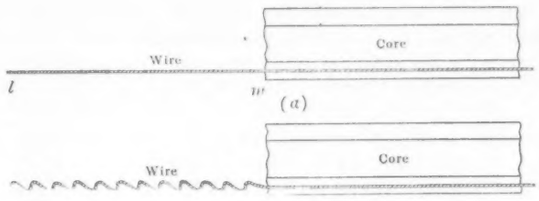


Fig. 9—Wired Electrode.

slowly so that the core fills up the inside of the shell, leaving no hole anywhere. If there is no connection between the core and the shell in any part, the current cannot pass from the shell to the core, which fault will cause a disturbance in the light when that part comes near to the burning end.

The flaming-arc electrodes destined for long-hour burning having a length of more than 16 in. have to be provided with a wire to reduce their electrical resistance. Such long electrodes without wires would entail a drop in voltage of about 10 volts or more, so that the arc would burn with different voltages during a single run depending on the length of the electrodes. In order to reduce this difference wires are inserted in the electrodes, as shown in the cross-sectional view, Fig. 8. In *a* the wire is embedded in the core and pressed against the wall of the shell by coring the carbon. In *b* a special groove is provided for the wire in connection with the core hole, so that it is filled up with impregnating material when coring the electrode. In *c* there is also a special hole for the wire, but separate from the core hole. It is, therefore, necessary to provide a good contact between the wire and the wall of the hole and this is done in the manner indicated in Fig. 9. The wire is first drawn through the hole till it projects out quite a distance. Then the part *l m* is crimped into the form shown in *b* by pressing it between two toothed wheels.

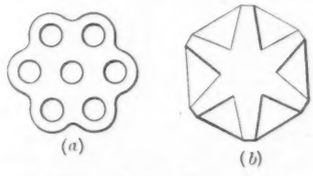


Fig. 10—Electrode for Regenerative Lamps.

The crimped wire is then drawn back into the shell, pressing against the wall of the hole and making good contact. In electrodes of the construction shown in Fig. 8*c*, where the wire is not prepared in the manner just described, the wire is of little or no use whatever because there is not sufficient electrical contact between the wire and carbon.

At the upper end, where the electrode is to be fixed in the holder, the wire is flattened and wound around the end of the electrode, thus causing a better contact with the electrode holder. A firm in this country electroplates and solders the end of the electrode to obtain the same result. Zinc, brass and tin wires are employed for this purpose. Brass wires can be used only in the construction shown in Fig. 8*c*, where the wire is separated from the core. When this wire is surrounded by the

core, as in the constructions shown in Fig. 8*a* and *b*, brass cannot be used on account of the copper contained in it, which on oxidizing covers the economizer of the lamp with a brown deposit. Aluminum wire has also been tried, but is found to be unsuited for this purpose, its surface soon being covered with a layer of oxide which insulates the wire from the carbon. The thickness of these wires varies from ½ mm to ¾ mm according to the thickness of the electrode.

The vertical electrodes for lamps of the Blondel type are distinguished by the thickness of their core, the latter forming about two-thirds of the entire diameter. These cores being too thick to be heated enough by the arc must, even when cold, be as good conductors of electricity as possible so that the arc can move easily around the whole cross-section. For that reason organic binders, such as glucose, are used. The metallic salts in the core form 30 per cent of the mixture only, while the carbon material comprises two kinds of baked lampblack of different mesh; one-third being a coarse flour passed through a sieve of 30 mesh per inch on a sieve of 50 mesh, and the other two-thirds being the fine flour generally used for coring. The coarse flour is intended for making the core electrically better conducting as well as preventing the shrinkage of the core when dried. The metallic salts used for these electrodes are the same as those used in the flame-arc electrodes described above. Potassium salts and boric acid are added for supporting the arc and take the place of the potassium silicate. The boric acid may be chemically compounded with the metallic salts.

Electrodes of quite another form are used in the regenerative lamps, Fig. 9 showing characteristic cross-sections. The negative electrode, represented by *a*, contains seven cores made of the same material as the cores of common electrodes, while the shell consists of pure, first-class carbon material. The positive electrode, shown by *b*, contains a star-shaped central part, containing about 75 per cent of carbon flour and 25 per cent of calcium and alkaline salts mixed with boric acid. The triangular grooves between the ridges of this part are filled by a mixture of calcium, tungsten and alkaline salts to which boric acid is added.

A pair of these electrodes has a life of seventy hours or more. The other flame-arc lamps have also been modified to give a longer electrode life, and since the shortness of life of the electrodes has been the chief obstacle to the extended use of flame-arc lamps in this country a large development in street lighting by these lamps may be expected in the near future.

SMALL MUNICIPAL HYDROELECTRIC STATION AT THURMONT, MD.

The attractive and well-designed power station shown in the accompanying illustrations stands as a highly practical monument to the progressiveness and generosity of certain public-spirited citizens of Thurmont, Md. This charming little town, situated at the foot of Catoctin Mountain on the Western Maryland Railroad, claims the distinction of being one of the best lighted towns in the State. Last fall a stock company was formed by a few of the leading citizens and with the generous co-operation of owners of several water rights affected by the proposed development, the necessary funds were raised and construction begun Nov. 4. The plant was completed July 1, 1910, and purchased by the town at cost.

Power is obtained from Big Hunting Creek. A substantial concrete dam 213 ft. in length was built at a suitable point in the mountain gorge through which the stream flows. The water is conveyed from the dam to the power house, a distance of 4350 ft., through a 28-in. wood stave pipe. The head on the wheels is 115 ft., making it one of the highest in Maryland.

The town is lighted with sixty-three 60-cp tungsten lamps and the citizens are justly proud of their clean, well-kept and well-lighted streets. A flat rate of 10 cents per kw-hour has been fixed for residence lighting. This charge is based on the estimated sale of energy and is subject to modification, a lower rate being contemplated as the load factor on the station increases. Twenty-four-hour service is given, so that during the day nearly 100 hp is available not only for the small mills whose individual water-powers were destroyed or diminished by the municipal development, but also for numerous minor industrial applications.

Fig. 1—Exterior of Power House.

The power-house equipment consists of two complete alternating-current generating units as follows: A 50-kw, 2400-volt, three-phase, 60-cycle generator with a 2-kw exciter, and a 30-kw generator with a 1.5-kw exciter. The generators are particularly well suited to the service. They are light in weight yet of rugged construction, well ventilated, simple in operation, with high efficiency and exceptionally low maintenance charges. Each generator is flange-coupled to a Trump high-head turbine of 90 hp and 50 hp respectively. The exciters are coupled to an extension of the generator shaft by means of an R. D. Nuttall flexible coupling. All the electrical equipment, including the switchboard, was furnished by the Westinghouse Electric & Manufacturing Company.

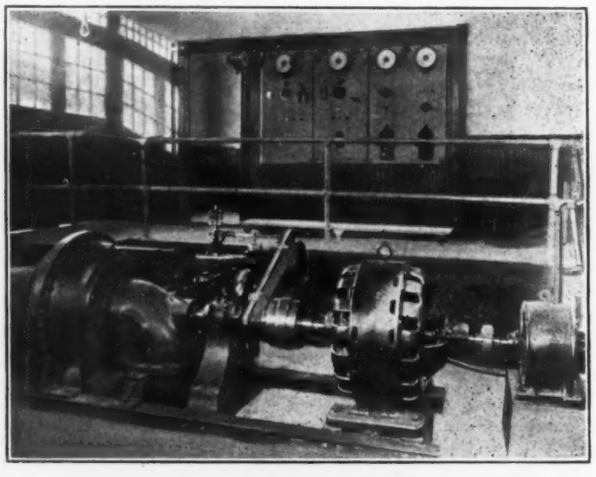


Fig. 2—Electrical Equipment.

The turbines are designed for operation under a 100-ft. head, and are supplied from the single-pipe line which terminates in a cast-iron Y at the power house. Each branch of the Y is provided with a gate valve so that either unit can be operated independently of the other. An interesting feature in the design of these wheels is the provision for taking up the end thrust by means of a water cushion instead of the usual wooden thrust blocks or rings.

A Woodward water-wheel governor of the compensating type is installed with each generating unit. This type of governor is especially designed to compensate for the fluctuation in pressure caused by the changing velocity of the water in the pipe line, as the gate opening is automatically adjusted under varying loads. The pipe line is also provided with a 6-in. Woodward pressure relief valve which acts positively on an increase of 2 per cent in pressure and closes with certainty when the pressure drops to its normal value. The rate of opening and closing of the relief valve is so adjusted that its operation will not cause shocks to the pipe line, and its capacity is such that no matter how quickly the gates are closed the pressure will vary but a few pounds from normal. This valve effectually protects the pipe line from excessive pressure and greatly facilitates the smooth operation of the governor and consequently of the entire system.

The plant has now been in operation for some months and is thoroughly satisfactory. As an example of what intelligent enthusiasm can often accomplish in the way of advantageous development of local resources Thurmont is an object lesson to many a small town with equal opportunities but less progressive public spirit.

Central Station
Management, Policies and Commercial Methods

ORNAMENTAL STREET LIGHTING IN REDLANDS, CAL.

Plans have been completed by City Engineer Hinckley, of Redlands, Cal., for the installation of a system of ornamental street lighting, using tungsten lamps supported by artistic posts, for several streets in that city. At a cost of $1.80 per front foot it is proposed to erect the posts and place the lamps and globes on portions of Orange Street, Cajon Street, State Street and Citrus Avenue at a total cost of about $15,000.

OFF-PEAK POWER SERVICE AT UXBRIDGE, MASS.

Mr. T. Russell Robinson, superintendent of the Worcester Suburban Electric Company, which operates in Uxbridge, Douglas, Whitinsville, Northbridge, Sutton, Millbury, Grafton and Upton, Mass., writes that the company has two installations of water-works pumping plants which are electrically driven. One plant requires 70 hp and the other 50 hp, and in each case the motor-driven pumps are the only apparatus in service. These installations are allowed to run only between the hours of midnight and 4 p. m., although in order to cover insurance requirements for protection against fire the company arranges to carry the pumping plants between 4 p. m. and midnight in cases of emergency, upon proper notice, and for an extra charge. One of the plants has been in operation four years, and during that time it has practically never been necessary to operate the pump after 4 p. m. The rates for these customers are divided up on a service connection charge and a running charge, and, since in some seasons of the year not as much water is needed as in others, this method of charge is equitable for both the consumer and the company.

COAL MINING BY CENTRAL-STATION ENERGY.

Certainly no more convincing demonstration of the efficiency of the central-station idea of energy supply could be given than the successful operation of coal mines and breakers from coal-burning central stations several miles distant. This is actually being done in the anthracite region of Pennsylvania, where certain mine properties, in spite of having almost free fuel and producing large quantities of culm refuse, have nevertheless found it to their own advantage to install electric motors and purchase energy from central stations in nearby towns. In the same region a number of coal mines and breakers having their own power plants are electrically driven, and the operators have already learned the convenience and flexibility of motor drive. To these advantages central-station service adds relief from heavy plant investment and first cost and from the annoyance of mechanical and labor troubles.

While the principal hoisting load, in the instances of the mines and breakers referred to, has drawbacks from a central-station viewpoint on account of its heavy demand and occurrence in peaks, the service required by pumping and blowing motors is essentially twenty-four-hour business, improving the load factor of the installation.

In the same anthracite field there are also a number of textile mills and other manufacturing plants which employ central-station energy for motor drive, although many of these factories are virtually built on culm piles and this material of an indifferent fuel value can be purchased at 30 cents a ton anywhere in the neighborhood.

The steaming mixture used under the boilers of the central-station plants in this region costs about $1.30 a ton. The energy which it produces large power consumers, such as the mines and mills, can purchase for 2 cents per kw-hour, or less. At such a rate certain mining operators, especially those having smaller holdings and lesser resources, appear to find operation with central-station service more advantageous than by an isolated plant with practically free fuel but heavy investment costs per unit of work done.

Mine-mouth generating plants with transmission lines into neighboring cities, eliminating coal haulage, have been proposed frequently, but no instance comes to mind where such a system has actually been installed—probably because careful figures did not disclose the great saving anticipated, after transmission losses and line investment and maintenance were considered. But it is nevertheless surprising to find the order now reversed and energy being delivered *from* the city generating station *to* the mine. Central-station energy has already been made use of for the operation of metallic-ore mines, examples being the interesting systems in the zinc and lead districts near Galena, Ill., and Joplin, Mo., and at other places in the West, which have been described in the *Electrical World*. In some cases, too, hydroelectric energy has been utilized for coal mining, the low cost at which the water-power could be purchased making it even cheaper than consuming coal to operate the mine. Electric drive has, of course, many advantages which the large coal companies have been keen enough to recognize in equipping their properties for operation from central private plants of large size.

But it will be hard to find more convincing evidence of central-station efficacy over isolated-plant operation than these instances in which central power plants in coal-mining regions can purchase fuel at current prices, convert it into electrical energy in their highly efficient large generating units and then dispose of this energy to the mines again, to the mutual advantage of all concerned. Although this operation is strikingly reminiscent of "carrying coals to Newcastle," it seems, indeed, that the last logical position of the isolated plant has been effectively invaded by central-station service. To the central-station solicitor having isolated-plant troubles on his hands the examples that have been cited should supply a moral well worthy the thoughtful consideration of even the most obdurate customer.

EIGHTEEN HUNDRED ELECTRIC VEHICLES IN CLEVELAND, OHIO.

Cleveland, Ohio, with its 500,000 inhabitants and its miles of well-paved, level streets, has 1800 electric automobiles in daily use, or one battery-propelled vehicle for every three gasoline cars. Not only is this the largest ratio of electric automobiles per capita for any city in the United States, but the actual number of vehicles, except for Chicago with its 2400 cars, is greater than in any other city in the country. The reasons for this splendid showing of electric automobiles, besides Cleveland's natural advantages of level plateaus, are assignable to several causes, chief of which, however, are the presence of several large automobile manufacturers in the city and the satisfactory low rate at which the local central-station company supplies energy for charging batteries. As might be expected under such circumstances, the cars of Cleveland manufacture practically dominate the local field in point of numbers. This condition has arisen, of course, owing to the nearby outlet which the Cleveland market affords, the special trained selling skill and enthusiasm which it has thus been possible to direct at this retail field, and the city pride and interest which Clevelanders feel for home-made products in the manufacture of which some of their friends may have an interest. In these respects alone has the electric vehicle situation in Cleveland been different from that in any other average prosperous American city, and with the same intelligent directive effort there is no doubt that similar results could be produced in other communities. Well-paved and level streets, good garage facilities and low cost of energy supply are the other qualities, which are probably equally shared by many other American cities. All of the principal makes of electric automobiles are represented in Cleveland, the Baker, Rauch & Lang, and Broc cars being manufactured there.

At least 75 per cent of the electric automobiles in Cleveland are stabled and recharged in private garages. Individual mercury-arc rectifier sets are installed, and for the energy used in replenishing the vehicles the Cleveland Electric Illuminating Company receives 5 cents a kw-hour, without demand or peak-hour limitations. As is well known, the Cleveland company employs a rate schedule charging 12½ cents per kw-hour for the first thirty hours' use of four-tenths of the principal lamp load of the residence installation. For all energy consumed above this amount, whether by the principal lamps or the so-called "unrated" load, such as lamps in back porches, back halls, bathrooms, yards, barns, cellars, etc., cooking and heating appliances, or storage-battery charging, the rate is 5 cents

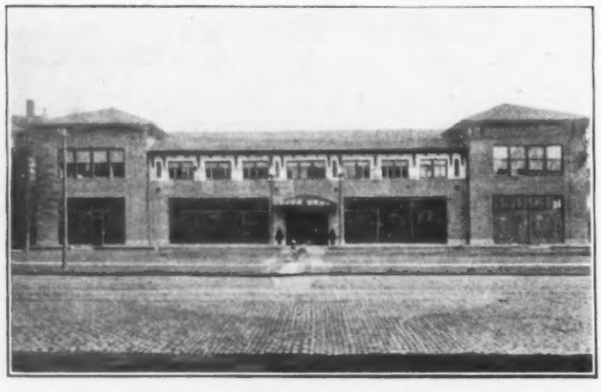


Fig. 1—Seventy-first Street Electric Garage, Euclid Avenue, Cleveland.

a kw-hour. By connecting the garage line under the same meter as the house, but without recording the automobile-battery charging demand in figuring the demand element, charging energy is obtained for the battery at the satisfactory rate of 5 cents a kw-hour without requiring a separate meter or customer's account.

The average private-garage installation in Cleveland brings the illuminating company a return of from $60 to $70 a year at the 5-cent per kw-hour rate. With each car consuming about 1400 kw-hours per season it is evident that the 1800 electric automobiles in Cleveland make use of more than 2,500,000 kw-hours per year, which, coming principally as off-peak demand, is no mean factor in the central-station load. In addition to the numerous private small garages at owners' residences there

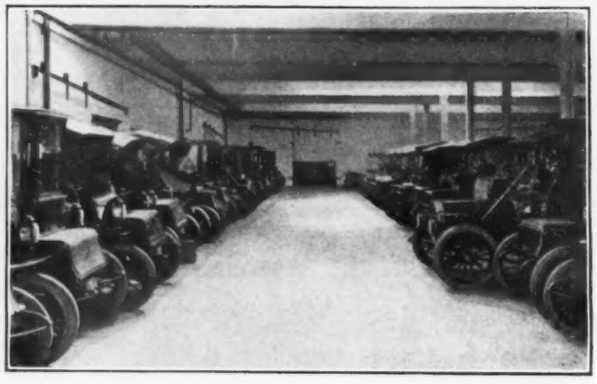


Fig. 2—Interior of Electric Automobile Garage, Cleveland.

are about twenty public garages in Cleveland which do charging. Purchasing central-station energy, as they do, in large quantities, these establishments obtain rates varying from 2½ cents to 2¼ cents per kw-hour. The garage rates for stabling electric cars, including charging, delivering, inspection, washing and minor adjustments, range from $25 to $35 a month, depending on the size of the equipment, average daily use made of the car and delivery service required.

To supply the needs of electric vehicle owners who prefer to keep their machines in public garages where they will have the benefit of expert attention several very fine exclusively electric garage buildings have been erected along the famous Euclid Avenue. These garages are attractive architectural ornaments of the high-class residential districts in which they are located, being placed back along the building line with broad green lawns and flower beds in front. The front show windows and rooms are in part used as sales offices for gasoline cars, but the large garage areas in the rear are employed entirely for stabling electric automobiles.

One of the best equipped of these public garages is that operated by the Baker Electric Vehicle Company at 7100 Euclid Avenue for the benefit of the large number of Baker car owners in Cleveland. This garage, the front of which is shown in Fig. 1, has facilities for caring for 100 automobiles, charging plugs being provided for replenishing sixty-six machines simultaneously, beside the battery-charging equipment in the battery-room. The front of the building is given over to handsome sales offices for the Baker and several gasoline automobiles, while above these are high-class bachelor apartments. Just within the main automobile entrance to the large 160-ft. x 200-ft. garage space in the rear, used exclusively for electric machines, is a hand-operated turntable onto which the cars can be run and turned for entrance to either aisle, or if necessary reversed without precarious maneuvering in the restricted space of the garage. The energy for charging the cars is obtained from the alternating-current distribution system of the Cleveland Electric Illuminating Company, being converted into direct current at 75 volts and 150 volts by 15-kw and 75-kw motor-generator sets. These pressures enable the cars to be charged with the minimum waste of energy in resistors, although rheostats are, of course, provided for regulating the current flow. By an ingenious arrangement of switch contacts a number of advantageous connections of one or more cars in series with the rheostats can be effected. The repair department of the garage is equipped to make any kind of repairs needed by electric vehicles, including lead-cell burning, etc. The rates for regular "boarding" of cars at this garage are: $25 per month for Imperials and stanhopes; $27.50 for vic-

torias; $30 for runabouts and coupés, and $35 per month for roadsters. At least 60 per cent of the electric vehicles in Cleveland are coupés, while about 80 per cent of all the new cars manufactured in the city are of this type.

The Rauch & Lang Company, whose factory is also located in Cleveland, has a large four-story garage building on Superior Street in the heart of the downtown district. While a limited amount of regular boarding of cars is done at this place, the establishment is operated principally as a convenience to electric vehicle owners who wish to leave their cars downtown while attending business or the theater. At the same time, the cars can be inspected and adjusted, the batteries charged, or the chains boiled, without delay in the owner's use of the car. The Superior Street garage can accommodate 10 cars on the first floor alone, overflow storage being furnished on the upper stories of the building. Charging facilities are provided for 126 cars. Half the upper floor is given over to the battery department.

While this special inspection service was inaugurated as part of the manufacturer's sales guarantee, and is furnished free to owners during the first year, it is also extended after this period to owners of these and other makes of automobiles, by the payment of $2 monthly. This amount entitles the car to the same inspection service and storage during business or theater hours, minor repairs, etc., and is a great convenience to electric owners, especially since a city ordinance of Cleveland makes it a misdemeanor to leave an automobile standing more than thirty

Fig. 3—Electric Garage Located at Sixty-sixth Street and Euclid Avenue, Cleveland.

minutes in the downtown streets. A number of drivers are on hand about the garage at all times to bring in or deliver cars to their owners, for which service a nominal charge is made, depending on the distance traveled.

Another one of Cleveland's handsome electric garages on Euclid Avenue is shown in Fig. 3. In this establishment all kinds of electric cars are handled and a few gasoline cars taken. Like the Seventy-first Street garage, the building is a pleasing one, roofed with red tile, and is surrounded by a broad lawn with flower beds.

As has been pointed out in the foregoing, the electric pleasure-vehicle business in Cleveland has been established on a substantial scale, and large investments have been made for carrying it on.

Electric pleasure vehicle owners are pleased with their machines, and the battery-charging loads provided by the cars represent substantial off-peak sales for the central-station company. As already intimated, the especially successful campaign in Cleveland, resulting in 1800 cars, has been due to the combined intelligently directed action of newspaper and theater-program advertising, personal solicitation, and, above all, the satisfaction given by the automobiles themselves. While the chief part of this work of introducing the cars has fallen on the representatives of the manufacturers, the electric company has co-operated by giving a low rate for energy, and by devoting some of its regular advertising space in the daily papers to pushing electric vehicles, thus stamping this type of automobile with its own approval.

Wiring and Illumination

THE PROFESSION OF ILLUMINATING ENGINEERING.

The last issue of the *Transactions* of the Illuminating Engineering Society contains the inaugural address of President A. E. Kennelly, which deals with the profession of illuminating engineering. Dr. Kennelly pointed out that illuminating engineering is the only profession which is in intimate relation with all of the arts and sciences underlying the various professions, namely, physiology, mathematics, physics, economics, business and esthetic arts. He stated that the public will not accept illuminating engineering as a profession unless there be a consensus of acknowledgment that illuminating engineering repays its cost abundantly. Each and every individual is prone to believe that he or she can light a street or a building as well as need be, without aid or suggestion, and nothing short of absolute demonstration that a trained illuminating engineer will do it not only much better than an untrained haphazard man, but also manifestly better, will satisfy the incredulous. However, the competent, trained illuminating engineer can light a street, dock, office, art gallery, theater or home very much better than can an untrained, haphazard man; moreover, he can demonstrate that there is by design ample light where it is wanted and little or none wasted where it is not wanted, that there is no needless glare, that the cost of the lighting is moderate and in harmony with the cost of the structures in other respects. Above all, he will be able for this expenditure to produce a much more graceful and pleasing illumination, in tones, intensities, colors, shadows and harmonies, than the haphazard man.

Dr. Kennelly stated as a general rule that any artificial lighting which forces itself upon the undirected attention of the observer is esthetically bad; good lighting is harmonious and satisfying, but unobtrusive. A good illuminating disposition will so blend with an esthetic environment as to enhance the sum total of pleasing so that the visitor is incited to admiration, but it usually takes some little examination to perceive the share of merit due to the lighting.

The illuminating engineer should maintain an unassertively co-operative attitude in the esthetic side of his work, but he is bound to maintain a vigorously assertive attitude in regard to its hygienic or physiological side. In every disposition of light sources that the engineer makes or examines it is his duty to point out and remove excessive luminous intensities from the lines of ordinary vision.

The good appearance of a room can be enhanced by bringing into stronger illumination the more beautiful or interesting portions of it. Prominent among the brightly illuminated and clamorous objects are apt to be the lamps themselves. Hence it follows that the observer is constantly apt to be reminded of the existence of a bright lamp in the room, if it lies near the level of his eyes. If the lamp, as a whole, has pleasing form and color, and these suit the environment, the perpetual stimulus to reconsider the lamp as a bright point on the retina may not be unpleasant. Unless the lamp is too bright and its visible surface has too high an intrinsic brilliancy there may be either a conscious or subconscious pleasure in its returning to the gaze. If, on the contrary, the lamp is unesthetic either in itself or in relation to its environment, the frequent stimulus to review it as a bright object may be a source of either conscious or subconscious distress.

A large and promising field open to illuminating engineering is the production of luminous colored decorative effects, both out of doors and within. The training of the public eye toward the appreciation of the beautiful in luminous display is probably slow, just as is true of the training of the public ear to the beautiful in sound. In the interior decoration of large public buildings relatively large expense in sources and patterns of colored light may be more than repaid to the

community if esthetic pleasure is produced, just as a fine symphony orchestra is an intellectual and emotional asset to a large city far beyond its cost. As time goes on we may look for closer co-operation between the architect and illuminating engineer in producing color poems during times when the landscape has been forbidden by the setting sun to steal away the gaze of admiration.

Dr. Kennelly stated that it is the duty of the illuminating engineer to aid the oculist and medical man in preserving at all times the hygiene of the eye, to see that the eyes of the student receive adequate light with no unnecessary glare or specular reflection from the studied page, and to check all unnecessary waste of energy in lamps uselessly employed.

STREET LIGHTING AT GRINNELL, IA.

By J. R. Cravath.

In the *Electrical World* of Oct. 14, 1909, page 923, an article described the plans which had been accepted by the City Council of Grinnell for a complete change in the street lighting system of that town. The system has now been in operation for some time and the results are worthy of comment for the benefit of other towns of 5000 population similarly situated.

The old system consisted of inclosed multiple 6.6-amp constant-potential arc lamps, each lamp being operated from a small transformer located in one of the nearby alleys and supplied from 1100-volt alternating-current primary feeders. These lamps were located usually at every other street intersection. The new system has a 100-watt, 110-volt multiple tungsten lamp on each street intersection. The small arc-lamp transformers are still located in the alleys as before, but each transformer, instead of feeding one arc lamp, feeds six of these 100-watt tungsten lamps. This system was selected rather than the series system, first, because of the lower cost of making the change from the existing system, and, second, because it avoided the use of high-voltage lines between the alleys and the street corners where the lamps were located. The problem of getting through shade trees with lines is especially difficult in this town. The company operates with a continuous grounded neutral wire in each alley and this neutral serves as a common return wire for both street lighting and commercial lighting purposes, though these services are supplied from different transformers.

The result of the change has been a remarkable transformation of the appearance of the town at night. One peculiarity of the new system, as compared with some others which have been installed, is that the lamps are located, not in the center of the street suspended from span wires, or at the curb line, as in some other cases, but directly over one of the sidewalk intersections at each corner. At first thought this might seem a peculiar location because the lamp is brought so far to one side of the street. The results amply demonstrate the correctness of the position of the lamps for these peculiar conditions, however, as most of the streets are lined with trees having very large trunks. With a lamp located in the center of the street, as were the old arc lamps, a considerable portion of the sidewalk was in shadow from the tree trunks. By locating the tungsten lamps over one of the sidewalk intersections at each corner the sidewalks in line with the intersection where the lamp is placed receive unobstructed light. The sidewalks on the opposite sides of the streets, of course, have the shadows of the tree trunks across them, but these shadows are much less objectionable and occupy less space on the whole than if the lamps were in the center of the street.

A very interesting point to be noted in connection with this installation is the great difference in the effective illumination of the sidewalks as compared with the roadways. While the sidewalks may be called very well lighted for pathfinding purposes, the roadways, although much better lighted than with the old arc lamps, still leave much to be desired as to illumination. The reason for this is the important fact, first prominently brought to the attention of illuminating engineers by Mr. Preston S. Millar in his paper at the 1910 convention of the Illuminating Engineering Society. This is, that we depend on the illumination of the street surface and the light background which it affords, rather than on the illumination of pedestrians and vehicles. The illumination of the street surface furnishes a light background against which we see objects approaching or obstructions as silhouettes. In other words, one of the first essentials is this light background. Applying this principle to the present case, the illumination of the sidewalks is good because they are of cement or wood and gray in color. The roadways on the unpaved streets are black Iowa soil, on which it requires a very high intensity of illumination to produce a background light enough for satisfactory street lighting.

The effect of "glare"—that is, the reduction of a person's ability to see, as caused by the presence of a lamp near the line of vision—is notably greater on the Grinnell unpaved streets when driving than when walking along the sidewalks. The glare of a lamp which one is approaching causes much more annoyance to the driver than to the pedestrian, for the reason that the contrast between the lamp and the black roadway surface is greater than the contrast between the lamp and the gray sidewalk surface. In other words, the effect of glare by reducing the ability to see is very greatly influenced by the surroundings of the lamp and the illumination received in the eyes from these surroundings. The greater the contrast between the lamp and its surroundings the more annoying is the glare effect. On the paved streets of the town, when they are dry, the glare effect is much less annoying than on the unpaved streets, because these streets are, like the sidewalks, gray in color.

The lamps are flexibly mounted in bracket fixtures with radial wave reflectors. The flexibility is obtained by packing hemp in between the socket and socket cover. No trouble has been experienced from abnormal breakages of lamps. The only serious trouble has been the stealing of lamps, not in the poor districts, but in the college section of town.

THE LIGHTING OF A LARGE STORE.

The New York Section of the Illuminating Engineering Society held its March meeting in the auditorium of Gimbel Brothers' department store on Thursday, March 9, at which time a paper was presented by Messrs. Clarence L. Law and Albert Jackson Marshall giving a description of the selection, installation and test of the lighting equipment of this store. The lighting equipment was described in our issue dated Sept. 29, 1910.

The authors described the lighting equipment in each room, gave photometric curves of each type of lighting unit employed and reported the results of tests of the illumination obtained at stated places throughout each room. In each case the measured illumination was somewhat less than the calculated value, the difference ranging from 1 per cent to 34 per cent. The tests showed that the absorption of light by the accumulated dust ranged from 6 per cent for the prismatic reflectors to 16 per cent for ground-glass balls.

When all lamps were in service the mean tested horizontal illumination varied from 1.9 ft.-candles in the restaurant on the eighth floor to 9.3 ft.-candles on the main first floor.

Discussion.

In opening the discussion Mr. P. S. Millar stated that from every point of view the illumination of the store could be considered good. Beyond doubt the density is adequate and the quality is as satisfactory as could be obtained with a single type of light source. However, it is possible that better results could be obtained by employing several different types of lamps in a department store in order to duplicate both daylight conditions and the different night conditions under which the various materials purchased may be used. He expressed the opinion that, from the point of view of lighting proper, the illumination on the first floor is excessive, but probably is justified in view of the advertising value of excessive brilliancy.

Mr. J. S. Codman agreed with Mr. Millar concerning the excessive brilliancy on the first floor and expressed the opinion

that the phenomenon of glare is too prominently in evidence.

Mr. H. T. Owens stated that the glare noticed in certain of the rooms is attributable not so much to the density of the illumination as to the arrangement of the fixtures. That is to say, the glare depends more upon the reflecting surface of the ceiling and the arrangement of the lighting units than upon the density of light flux obtained from the lamps.

Mr. G. H. Stickney said that, although there can be no doubt that tungsten lamps produce the best general effects for the illumination of all floors above the first, yet it is possible that the so-called intensified arc lamps may be better suited for the illumination of the first floor. Arc lamps are more efficient and have a greater advertising value.

In reply to questions by Messrs. S. W. Ashe and Norman Macbeth, Mr. Marshall stated that the tests reported in the paper were made about five months after the lighting equipments had been installed. Some of the lamps were old and some of them were new, and in the tests so specified the dust collection had been that resulting from five months' use. The tests were based on an assumption of 120 volts at the lamps. The actual voltage varied from this value, but the variation was very slight and the corrections were relatively inappreciable. He stated that in arranging the lighting equipment for the first floor much more attention was paid to the advertising value than to the illumination. This fact accounts for the excessive illumination employed. He expressed the opinion that, although the lighting of the Gimbel store is satisfactory, even better results could be obtained by concentrating the light over the counters, with a corresponding decrease in light along the aisles, which method is preferable to employing uniform illumination throughout the whole area lighted.

NEW TELEPHONE PATENTS.

SELECTIVE SYSTEMS

Two four-party selective systems have been patented by Mr. J. Erickson, of Chicago. In each system the selection is based upon the use of two generators with shafts coupled and oppositely poled. In one system the ringer magnets are supplemented by a locking magnet which exerts its pull directly upon the bell clapper, which is made of magnetic material. At one station the bell is connected to ground from one side of the line and the lock from the other side. At station No. 2 these conditions are reversed. At stations Nos. 3 and 4 the two sets of coils are in series and grounded at the middle, but the relative direction of the windings upon the different magnet limbs is changed. Station No. 1 responds to current from one generator upon one side of the line. Station No. 2 receives no current at this time. Stations Nos. 3 and 4 have their lock magnets energized. If current be applied to the other side of the line, Station No. 2 responds and No. 1 fails. Stations Nos. 3 and 4 fail as before. For station No. 3 one generator is connected to both sides of the line simultaneously. The locks of stations Nos. 1 and 2 become effective. Station No. 3 responds, the locking magnet coils acting differentially. Station No. 4 fails, as the lock is effective. For station No. 4 both generators are used. Stations Nos. 1 and 2 are locked, and No. 4 responds.

In the second system there is substituted an electrical locking device, the contacts of which maintain the bell short-circuited at each station except when that current combination is sent which tilts the armature.

LOCK-OUT DEVICE.

A lock-out device has been patented by the same inventor. This is an apparatus including a selector, hook switch and control magnet such that the hook-switch springs are ineffective if the magnet be energized. With automatic systems using party lines such an arrangement prevents one station from interfering with the connections established to another station on the same line.

BUSY-TEST SYSTEM.

A busy-test circuit forms the subject of a patent issued to Mr. C. S. Winston, of Chicago. The circuit is used with a two-wire common-battery system. The calling-plug tip is connected through an auxiliary back contact of the supervisory relay, thence through an auxiliary contact of the listening key and through a retardation coil to ground. A tertiary winding of the operator's induction coil is connected from the retardation coil through a condenser to the live pole of the battery. This patent has been assigned to the Kellogg Switchboard & Supply Company.

LETTER TO THE EDITOR.

Capacity of Condensers in Parallel.

To the Editor of Electrical World:

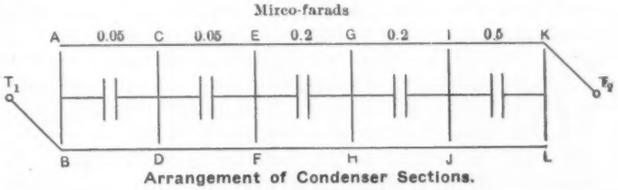
SIR:—In his communication to the *Electrical World* for Feb. 16, 1911, Mr. B. O. Lenoir endeavors to explain the behavior of his condenser under the conditions shown in his Fig. 1 by electrostatic induction on the unused plates. As a matter of fact, no such assumption is necessary if his diagram is carefully studied. The 0.1-mf and the 0.2-mf sections are in series with each other, the combination being in parallel with the remaining sections. He states that a throw of ten was observed under these conditions, while only eight deflections occurred for the 0.3-mf condenser used as a standard.

By assuming that the capacities are directly proportional to the deflections, which is true if other conditions remain constant, it is possible to calculate the capacity observed and compare it with the capacity computed. Thus, $8:10::0.3:x$; $x=0.375$ mf (observed capacity). The equivalent for the capacities in series is: $1/C=1/0.1+1/0.2$; $C=1/15=0.067$ mf. Hence the computed capacity in the condenser is:

$$0.01+0.02+0.02+0.05+0.067+0.2=0.367 \text{ mf.}$$

It is quite possible that the reason for observed and calculated values not checking is a slight inaccuracy in reading the galvanometer deflections; it is rather difficult to read the ballistic swing of a galvanometer to tenths of a centimeter or large deflection, as the case may be.

In order to make clear the principle of action of a variable condenser, the following combinations and galvanometer readings are appended. How accurate the various sections are



Arrangement of Condenser Sections.

may be determined from the recorded readings. The sections were merely compared against each other.

Referring to the accompanying illustration, with the plugs in *E*, *H* and *I*, or 0.2 mf and 0.2 mf in parallel, C is 0.4 mf, and the observed galvanometer reading was 14.3. With the plugs in *E*, *H* and *K*, or 0.2 mf in parallel with 0.2 mf and 0.5 mf in series, the galvanometer reading was 12.3. By ratio of deflections $(12.3/14.3)\times 0.42=0.344$ mf is the observed capacity, while $0.2+\dfrac{1}{1/0.2+1/0.5}=0.343$ mf is the computed value.

With the plugs in *E*, *J* and *K*, or 0.5 mf in parallel with 0.2 mf and 0.2 mf in series, the galvanometer reading was 21.4. The plugs might also have been placed in *F*, *I* and *L* with the same result. By calculation $0.5+\dfrac{1}{\frac{1}{0.2}+\frac{1}{0.2}}=0.6$ mf is the capacity. With the plugs in *A*, *D*, *E*, *I* and *L*, or $0.05+0.05+0.5$ in parallel, *C* is 0.6 mf and the galvanometer de-

flection was 21.4. The plugs might also have been placed in *B, C, F, J* and *K* with the same result.

The last two sets of readings check exactly with each other, although the capacities in the two cases were obtained in entirely different manners. The one is a series-parallel arrangement of the sections and the other a simple parallel connection.

It is seen from the foregoing that the condenser illustrated offers a range of capacities from 0.0194 mf to 0.1 mf.

Philadelphia. CHESLEY H. JOHNSON.

[Our correspondent intimates that the explanation by Mr. Lenoir based on "electrostatic induction" is incorrect, but fails to explain how condensers in series can be charged other than by induction.—ED.]

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Chemical Action in the Windings of High-Voltage Machines.—A. P. M. FLEMING AND R. JOHNSON.—A paper read before the (British) Institution of Electrical Engineers giving the results of tests and investigations on the failure of machines due to chemical action. No case of chemical action has been observed on windings having a voltage lower than about 3500 to ground, as, for instance, 6000-volt, three-phase, star-connected machines. Chemical action occurs only where air-pockets are present, and then only when the voltage across them is high enough to produce a discharge. While the action commences on the surfaces of the insulation exposed to air-pockets, the gases produced by the discharge may be carried beyond the zone where they are formed and produce action on other portions of the insulation outside the slots. While a discharge undoubtedly occurs between the outside of the insulation and the laminations, very little chemical action is to be expected on the exposed surface, since the gases formed can freely escape, and, further, the insulation is not usually of a kind readily affected. The action of the products of the air-gap discharge—whether these be ozone, oxides of nitrogen, nitrous or nitric acid—on the insulation is most commonly one of oxidation, and the effects produced on different materials are as follows: Untreated cellulose materials have their fibrous structure readily destroyed and disintegration follows. The oils and gums used in the preparation of insulating varnishes are practically all subjected to superoxidation, and as a result yield organic acids. Of these materials linseed oil is most readily affected. Certain asphaltum compounds are attacked only to a limited extent, and paraffine wax appears to be quite unaffected. Mica is itself unaffected, but the cements used in building it up are liable to attack on exposed surfaces. The production of nitric acid is not essential for deterioration of the insulation to occur, although when it is produced the action is greatly accelerated. The final disintegration of varnish-treated materials is greatly accelerated by the action of the released organic acids. Failure due to chemical action is almost invariably the result of a short-circuit between turns, and not, as is sometimes supposed, of a breakdown of the slot insulation between windings and ground. The short-circuit is caused either by a destruction of the insulation on the conductors, which allows the turns to make actual contact, or by the hygroscopic, and therefore conducting, matter formed between conductors when nitric acid is present. Unless the air in the cavities of the winding is replenished by "breathing" the chemical action will cease. When the stress on insulation is very high deterioration other than that due to chemical action may be produced. Thus, if the insulation is made up partly of materials of high specific inductive capacity, such as mica, and partly of materials of low specific inductive capacity, such as paper, the insulating value of the latter may be destroyed without the insulation as a whole breaking down. The precautions to be taken are then discussed under the following three heads: Potential gradient, safe working stress for any method of insulating and special methods of insulating for very high stresses. The final conclusions reached by the authors are as follows: For the range of voltages at present used failure of machines from chemical action is not to be expected when the average stress across the slot insulation is less than about 35 volts per mil with any of the methods of winding and insulating commonly employed. With windings having an e.m.f. of less than 4000 to ground the stress is usually kept below this limit by the ample thickness of insulation required for mechanical reasons. An average stress much larger than 35 volts per mil of slot insulation is safe when the size and number of conductors permit the best method of grouping and insulating to be employed, and when special precautions are observed as to the kind of materials used and the proper filling of interstices. Failure due to chemical action is almost invariably the result of a short-circuit between turns of the windings and not of a breakdown through outer insulation to ground. On this account mica or other material which is unaffected by chemical action should be used between turns whenever this action is likely to occur. While failure due to chemical action may be prevented by proper precautions, even when very high stresses are employed, there is in such cases some risk of producing a partial breakdown of the slot insulation when the ordinary pressure tests are applied. Such weakening is likely to occur when layers of material of high and low specific inductive capacity are used together, the insulation value of the latter being destroyed. In this connection it should be noted that a pressure test affords no criterion as to the safety of windings against chemical action, since the stress at which the latter takes place is usually far below that at which disruption of the insulation occurs. The green discoloration which frequently occurs on coils of any voltage treated with linseed-oil gum varnishes should not be confused with the chemical action due to the products of the air-gap discharge which takes place in high-voltage windings only. Such discoloration is quite harmless with the best makes of varnish.—Lond. *Electrician*, Feb. 24; Lond. *Eng'ing*, Feb. 24.

Sliding Contacts.—J. E. NOEGGERATH.—The first part of a paper giving the results of an extended investigation on the possibility of collecting currents by brushes from a revolving slip-ring at very high speeds. It was formerly considered that the maximum possible peripheral speed was 30 m per second

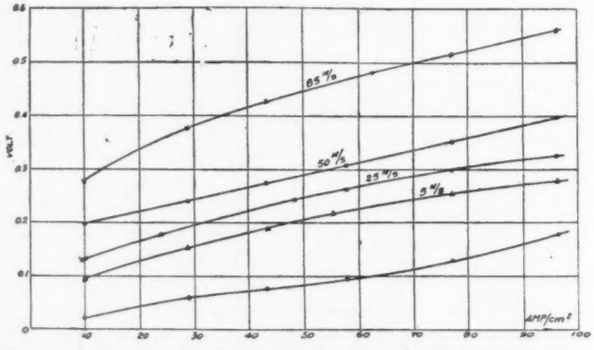


Fig. 1—Voltage Drop at Contact for Various Speeds in Meters per Second.

(6000 ft. per minute). In his unipolar machine the author needed higher speeds and the investigation carried out as to the maximum permissible speed showed that it is possible to collect currents with a brush from a slip-ring revolving with

a peripheral speed of 100 m per second or more. The author found that the phenomena in the sliding contact have some similarity with certain phases of electric arcs. He used in the tests chiefly rings of rolled hard copper and of soft steel. He first discusses the electric phenomena in the sliding contact. The effect of current density and speed on the voltage loss in the contact for a copper-ring with a brush pressure of 0.15 kg per square centimeter is shown in Fig. 1. The lowest curve refers to the case in which the ring is at rest and simply represents Ohm's law. The higher curves refer to speeds of 5 m, 25 m, 50 m and 85 m per second respectively. These are also practically straight lines, but no longer pass through the zero point. In other words, besides the ohmic voltage drop there is an additional voltage drop which is given by the distance of the different curves from the curve referring to the slip-ring at rest. The relation which determines the value of this additional voltage drop is exceedingly complicated. Among other things, it depends upon the mechanical condition of the sliding surfaces, lubrication, etc. The author then gives the results of determinations of the losses, giving both the contact loss and the friction loss and also the sum of the two. For high speeds the total brush losses are practically independent of the speed. The author then discusses "primary mechanical effects." When the slip ring is rotating the forces which exist tend to remove the brush from the slip-ring. Often the degree of unevenness of the slip-ring surface has only a small influence on the losses at high speeds. With a well-constructed brush it is not necessary to employ a high pressure. The limit of permissible speed is not set by the brush losses, but by the wear and tear and the high centrifugal force acting on the ring, although air friction is also of importance. From present experience it may be estimated that the upper limit of the speed is 200 m per second (40,000 ft. per minute). The paper is to be continued.—*Elek. Kraft. u. Bahnen,* Feb. 14.

Unipolar Dynamo.—E. GROTE AND F. DAVISON.—A paper read before the South African Institution of Electrical Engineers describing "a suggested commutatorless direct-current generator." It is intended to generate direct current at high tension in the armature without the aid of commutation and with only two or four slip-rings and is believed to be an improvement on existing unipolar machines. The machine has not yet been tried experimentally. In the discussion which followed several speakers expressed the opinion that the machine would not work.—*Trans. So. African Inst. Elec. Eng.,* September, October and November, 1910.

Alternators in Parallel.—J. R. BARR.—A paper read before the Glasgow Section of the (British) Institution of Electrical Engineers in which he discusses the various causes which lead to unstable operation and an examination of what precautions must be taken in the design of an alternator in order that it may work satisfactorily in parallel with other sets.—Lond. *Electrician,* Feb. 24.

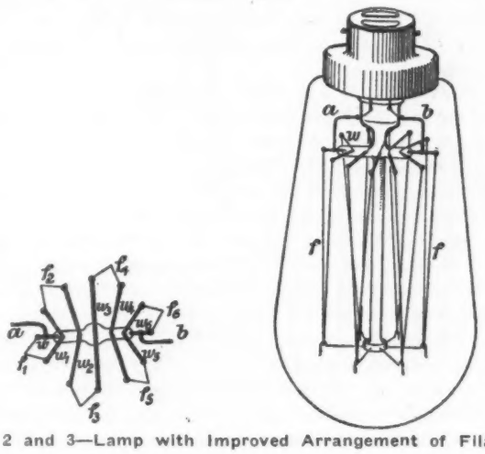
Induction Machines.—R. RÜDENBERG.—An English translation of his German paper in which he shows how the vector diagrams for stator and rotor of a machine with a rotary field can be combined by giving different velocities to the time lines of the two diagrams. He then points out that above synchronism the rotor leakage is negative and therefore the reactance drop is in advance of the current.—Lond. *Electrician,* Feb. 24.

Construction of Electrical Machinery.—L. BERGER.—Abstracts and discussions of various recent papers which have already been noticed in the Digest, among them that of Fischer-Hinnen on construction of electrical motors with vertical axles; a paper by Czepek on the mechanical stresses on the windings in high-speed machines, and a paper by Czepek on iron losses.—*La Lumière Elec.,* Feb. 25.

Repulsion Motor.—F. RUSCH.—The conclusion of the paper in which the author applies his theory to the calculation of a 200-hp traction motor.—*Elek. Zeit.,* Feb. 23.

Lamps and Lighting.

Metallic-Filament Lamp.—L. MURPHY.—A letter on the breaking of filaments in metallic-filament lamps. The author has found that in many cases the filaments break at, or close to, one of the leading-in wires, due to the discharge which must take place across this narrow gap when the pressure is applied and the filament heated. When an attempt is made to repair such a filament it will often be found that either the filament is too short to reach its correct position or, if broken a little way from the support, it will catch across the adjacent filament owing to electrostatic attraction, and the lamp is short-circuited and ruined. The writer suggests that the leading-in wires should be joined to the filament at the opposite ends of a diameter of the lamp, and this may be achieved by connecting the filament loops as shown in the diagrams, of which Fig. 2 indicates the path of current, while Fig. 3 shows how the construction would be carried out in practice. The leading-in wires are shown at *a* and *b*, and the filament loops at f_1, f_2, etc., while w_1, w_2, etc., are wires embedded in the glass support for the purpose of connecting the filament loops in series. It will be noted that the current crosses the lamp between the end of each loop and the commencement of the next, so that the maximum pressure existing between any two adjacent parts is the fall of pressure in one loop only. If this construction were adopted there would be much less tendency to rupture and greater likelihood of a repair when this does occur.—Lond. *Electrician,* Feb. 24.



Figs. 2 and 3—Lamp with Improved Arrangement of Filament.

Arc-Lamp Globe.—A note on a recent British patent (9209, Feb. 16, 1911) of the Allgemeine Elektricitäts-Gesellschaft. To prevent the deposit on the inside of the globes of inclosed-flame lamps the upper portion is provided with an air jacket of glass to keep it hot. The fumes are thus condensed only on the lower portion of the globe, where a deposit does not interfere with the light radiation. A device for regulating the air pressure in such a jacket is described.—Lond. *Elec. Eng'ing,* Feb. 23.

Generation, Transmission and Distribution.

Turbo-Generators in Gas Stations.—C. RICHTER.—The conclusion of the paper in which the author shows that in a plant driven by gas engines the use of a few steam turbo-generators is advantageous. On account of their lower first cost and lower cost of operation this method can result in considerable saving if at periods of low load some of the excess gas is employed for heating boilers for the steam turbines, since the higher efficiency of the gas engine would then be of no account. It is also shown that turbo-generators may be used in a rational way to carry the intermitting peak loads in a gas-driven plant Complete figures are given of the saving which may be expected under certain assumed conditions.—*Elek. Zeit.,* Feb. 23.

Northeast Coast of England.—The first part of an illustrated article on electric developments on the northeast coast of England. A review is given of the industries in this district and the history of the chief generating stations. Five of the newer stations produce electricity from waste heat; three of these, with an aggregate rating of 15,000 hp, utilize coke-oven gas, and two, of 9000 hp total rating, use exhaust steam.—Lond. *Eng'ing,* Feb. 24.

Isolated Plant.—An illustrated description of the new generating station built by the Midland Railway Company in England for supplying electric energy to its Derby works. There are two 1250-kw steam turbo-generators supplying three-phase currents at 440 volts directly to the works. For crane driving direct current at 440 volts is obtained by rotary converters.—Lond. *Eng'ing*, Feb. 24.

Dangerous Rises in Voltages.—J. Giles.—A paper illustrated by diagrams presented before the International Society of Electricians in Paris discussing the protection of networks against dangerous rises of voltage or increases of current, both from external causes and from causes within the network itself.—*La Lumière Elec.*, Feb. 18.

Traction.

Controller.—A note on a recent British patent (29,785, Feb. 16, 1911) of the British Thomson-Houston Company, H. C. Hastings and W. L. Wise. This is a reversing controller for series-parallel control and permits of a faulty motor being cut out without interfering with the remaining motors. A separate drum is provided for each motor or group of motors. These are mounted loosely on a common spindle with means for locking them so as to rotate with the spindle. Each drum carries three sets of contacts; one set engages the fingers when the handle is in the "reverse" position, another when the handle is set for forward running, and the third set engages with the fingers in such a manner that the corresponding motor or group of motors is cut out. Thus, to cut out a motor the corresponding drum is fixed in this position, while the others are free to rotate with the spindle.—Lond. *Elec. Eng'ing*, Feb. 23.

Railless Traction.—E. Kindler.—A fully illustrated description of a railless traction system for running omnibuses in the City of Bremen in Germany. Energy is supplied by means of two trolley wires vertically above each other at a distance of 27.5 cm (11 in.), the positive wire being below the negative wire. This method is claimed to simplify construction. The equipment of the cars is described in great detail.—*Elek. Zeit.*, Feb. 24.

Installations, Systems and Appliances.

Limit Switch for Direct-Current Installations.—Numerous schemes have been put forward whereby the domestic consumer is enabled economically to take a constant demand from the network instead of throwing a peaky load on the station. The usual proposition comprises a resistance which allows a current equal, or nearly equal, to the maximum demand of the house—that is, inclusive of any lighting, heating or cooking apparatus that may be fitted—to flow all day and to perform useful work in heating water when not otherwise needed. At a time when none of the electrical apparatus is in circuit all of the current is used for heating water by means of the main resistance. As a demand arises for light or heat, other than for the water supply, more or less resistance is cut out so that the total demand always remains the same. A method for this purpose, devised by P. Good and Toulmin-Smith, makes use of three resistors connected in parallel across the mains of the City of London Electric Lighting Company. These provide the constant demand for which the supply company charges at the rate of 14 cents per watt per annum. They are immersed in a cistern at the top of the house, where the domestic hot-water supply is obtained. The cistern is lagged, but is otherwise unaltered. This arrangement allows enough hot, not boiling, water to be obtained for ordinary domestic purposes, together with one hot bath a day. During the evening, when, of course, the resistors are not in circuit for any long continuous period, the temperature of the water drops slightly, but otherwise remains fairly constant. The switch by means of which these resistors are cut out consists essentially of a long, round iron core over which, but at some distance away, is placed a cylinder of sheet iron. Between these two and surrounding the iron core are placed the coils, one fixed at the top of the core and the other at the bottom, with a third in the center, which is free to move up and down the inner core round which it is wound. The fixed coils are in series with the resistors and the movable coil is in series with the lamps or other apparatus on the installation. When a lamp is switched on the movable coil becomes slightly energized and is attracted up the core a certain distance. This movement cuts out one of the resistors. Switching on more lamps cuts out another resistor, while a third movement cuts the last resistor out. Of course, with such an arrangement it is impossible to keep accurately to the stated demand. On the other hand, it is quite possible to keep within the limits laid down by the supply company, and this is all that is needed. A fourth contact switches in a dimming resistor and comes into action when the standard demand is much exceeded. As the lighting demand decreases the switch falls back by gravity.—Lond. *Electrician*, Feb. 24.

Wires, Wiring and Conduits.

Network Analysis.—J. R. Dick.—A paper fully illustrated by diagrams in which the author discusses two methods of network analysis, both of which are ultimately dependent on Kirchhoff's laws, to discover whether a conductor is being overloaded and to find the exact voltage at a point where there are no pilot wires. The two methods given are the current and voltage methods. These are analyzed and examples showing how they are employed in practice are worked out.—Lond. *Electrician*, Feb. 24.

Electrophysics and Magnetism.

Hysteresis Loss.—R. Jouast.—The author reviews the recent paper of Richter, who prefers the formula $aB + bB^2$ to Steinmetz's formula $cB^{1.6}$ for the hysteresis loss. The present author states that the Steinmetz formula represents the facts for all steels for which with an induction of 10,000 the Steinmetz coefficient is above 0.002. On the other hand, for steels with low hysteresis loss a formula containing two constants is preferable, or even necessary. He believes that a more general formula, such as that of Richter, is better adapted for the general purposes of electrical engineers.—*La Lumière Elec.*, Feb. 25.

Electrochemistry and Batteries.

Refining of Pig Iron in the Electric Furnace.—J. B. Nau.—An article on the use of the electric furnace for the preliminary refining of pig iron, more especially of phosphoretic pig iron too high in silicon to be treated directly and economically in the open-hearth furnace. This method consists of running the liquid iron from the blast furnace through a column of heated ore and letting a bath of metal accumulate on the bottom in such a way that the lower part of the refining ore column is kept immersed in the liquid iron. In order to obtain the correct temperature the process can best be carried out in an electric furnace. The author gives a balance sheet of the materials and a heat balance sheet of the process and calculates the electrical energy required.—*Met. and Chem. Eng'ing*, March.

Electrolysis in the Paint and Varnish Industry.—F. M. Perkin.—A paper read before the (British) Paint and Varnish Institute in which the author discusses the application of electrolytic methods to materials used in the paint and varnish industry. White lead and certain metallic pigments can be made by electrolytic means, but the subject has not been very thoroughly worked out as yet. There is room for research, and such research would prove of great value to the paint and varnish trade. Electrical energy can now be produced at a very low rate, so that the cost of energy is not the hindrance it would have been some years back. The actual energy cost might be almost negligible, provided the pigments obtained were better either in color and shade, or in state of division, than those made by other methods or, again, if certain pigments which are not readily obtained by other means could be more easily made electrochemically—Lond. *Electrician*, Feb. 24.

Aluminum.—W. Clacher.—Some notes on the manufacture of aluminum as carried out by the British Aluminum Company. The allocation of cost is given as follows:

	Per Ton.
Energy	$25.00
Carbon	32.50
Alumina	140.00
General expenses and profits	140.00
	$337.50

Some notes are added on the purification of bauxite.—*Met. and Chem. Eng'ing*, March.

Manufacture of Carbon Electrodes.—W. CLACHER.—An illustrated description in some detail of the method of the manufacture of carbon electrodes in use at the works of the British Aluminium Company, with special reference to the chemical problems involved and the machinery used.—*Met. and Chem. Eng'ing*, March.

Electro-Analysis.—R. C. BENNER.—An illustrated article on a new form of gauze electrode for the rapid electrolytic determination of lead and copper.—*Met. and Chem. Eng'ing*, March.

Units, Measurements and Instruments.

Measurement of Permeability in Low Fields.—E. GUMLICH AND W. GROGOWSKI.—The measurement of the permeability of iron in very small fields has recently become of importance for practical purposes, for instance, in connection with Pupin coils, instruments, etc. For this purpose it is absolutely necessary to have a method by which the sample under test can be completely demagnetized, since even traces of remanent magnetism can cause considerable errors. The authors have found by experience in the Reichsanstalt that the least trace of magnetism can be removed if the demagnetizing alternating current is decreased with absolute uniformity, without any sudden changes, such as always occur with commercial rheostats. The authors have devised an apparatus in which this result is obtained and give the results of tests of various iron and steel samples in a table.—*Elek. Zeit.*, Feb. 23.

Induction Meter.—A ILIOVICI.—The conclusion of his paper on the theory of the disk induction meter. In the present intalment the author gives some practical conclusions and experimental verifications. Among his practical conclusions are the following. On the one hand, it is necessary that the thin-wire coil represents as nearly as possible an ideal reactance coil—that is, it should have a relatively low ohmic resistance. On the other hand, the disk should fulfil the opposite condition and have a high resistance and a low inductance. The author concludes that aluminum disks are preferable to copper disks and that a large air-gap is required.—*La Lumière Elec.*, Feb. 18.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—G. E. PETIT.—The author shows how it is possible by means of two vertical wires to determine at a receiving station the direction from which a wireless message is received. He uses an arrangement which he calls radio-phase meter.—*La Lumière Elec.*, Feb. 25.

Miscellaneous.

Heating Apparatus.—A note on a recent British patent (10,595, Feb. 16, 1911) of Evershed & Vignoles, A. Schneider and W. Clark. A heating element consists of a resistance wire wound longitudinally or spirally in grooves on a tube of soapstone or steatite. An envelope of copper entirely surrounds the coil and has an extension passing up the center of the core. The insulation between the copper and the wire may be mica, but is preferably air only. The copper envelope is in direct contact with the body or vessel to be heated.—Lond. *Elec. Eng'ing*, Feb. 23.

BOOK REVIEW.

THE WATT-HOUR METER. By William M. Shepard and Allen G. Jones. San Francisco: The Technical Publishing Company. 184 pages, illus. Price, $2.

The purpose of this book is to supply the central-station manager, the practical meter man and the student with information relating to the watt-hour meter, its installation, testing and maintenance. Four of the eight chapters are descriptive of various types of meters. One chapter treats of the selection of meters and various points affecting their accuracy, and the remaining chapters relate to measurement of energy, maintenance and testing, and rates. An appendix contains definitions of some electrical terms and several pages on testing and adjustment that appear to belong in the body of the book. We fear that the mathematical treatment of the effect of power-factor and on the use of single-phase meters on polyphase circuits will be found rather difficult reading by the practical meter man. Otherwise the information given is quite practical in character, and the book as a whole will be found useful by everyone having to do with the installation, testing and maintenance of watt-hour meters.

New Apparatus and Appliances

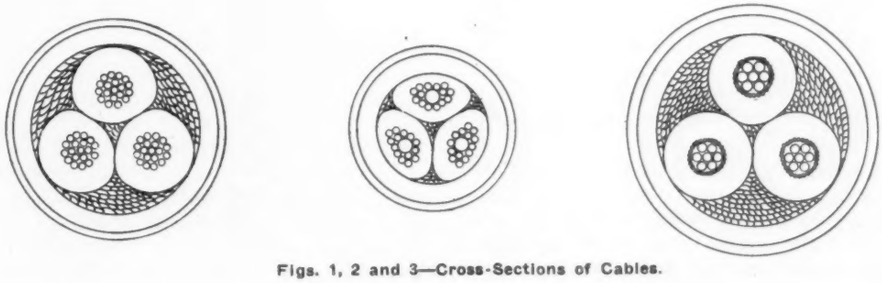
HIGH-VOLTAGE CABLES.

The cables illustrated herewith have been built for high-voltage operation and hence possess features of much interest from the point of view of insulation. The main insulation consists of a specially prepared impregnated paper which is capable of withstanding about 2.5 times as great a "puncture" voltage as the American manila paper frequently used for a similar purpose.

Fig. 1 is a sectional view of a cable designed for a normal working e.m.f. of 20,000 volts, the test e.m.f. being 60,000 volts and the puncture e.m.f. in excess of 200,000 volts. Each conductor has a cross-sectional area of 100 sq. mm (about 200,000 circ. mils).

Fig. 2 relates to a 10,000-volt cable tested at 30,000 volts. Each conductor section is 70 sq. mm (140,000 circ. mils).

Fig. 3 shows a section of a cable which has been tested at 150,000 volts and is intended for operation normally at 60,000 volts. Each conductor has a cross-sectional area of 100 sq. mm (200,000 circ. mils).



Figs. 1, 2 and 3—Cross-Sections of Cables.

These cables have been built for the market by the Siemens-Schuckert Werke, Berlin, Germany.

AUTOMATIC FUEL-OIL REGULATION.

Practically all oil-fired boiler plants are controlled by hand. Steam as well as oil is regulated at each individual burner and the dampers are also subject to hand control. Results obtained are hardly ever satisfactory, thereby lowering the efficiency of the boiler plant. The first notable step in advance of hand firing was at the plant of the Pacific Electric Railway Company, Los Angeles, Cal., where, under the directions of the chief engineer, one man stationed near the oil pumps, running at practically constant speed, controlled eighteen boilers, or fifty-four burners, by opening or closing a bleeder valve on the oil-pump discharge line, thereby increasing or decreasing the pressure in the oil main and simultaneously the rate of firing of all the boilers. After this it was a simple matter to substitute automatic regulation for hand control, thereby developing the Moore automatic fuel-oil regulating system, built by Charles C. Moore & Company, San Francisco, Cal. This system controls the supply of oil to all burners, the supply of the atomizing agent to all burners and the supply of air for combustion for any number of boilers all from a central point. The results are increased boiler-plant efficiency, the practical prevention of smoke and the decrease in the maintenance cost of boiler equipment due to a more uniform manner of firing. A system of this kind was first installed at the Redondo plant of the Pacific Light & Power Company in 1907, where the regulating system is used to control the entire plant of eighteen boilers of 600-hp capacity each, and the increased economy, due to uniform rate of firing, is very evident. Under actual operating conditions this system of regulation has been found absolutely reliable.

COMBINATION SOLDER AND FLUX.

The Solderall Company, 143 Liberty Street, New York, has brought out a new form of solder for general electrical work. The compound consists of a pulverized tin solder combined with a special non-corrosive flux made into paste form and put up in convenient collapsible tubes. The advantage of the compound is its convenience in handling, being complete and ready for instant use. A little is squeezed from the tube on the parts

Collapsible Tube Containing Solder.

to be joined and the application of heat completes the job. For joining wires and small work an ordinary match is said to suffice, while for larger work a hot iron or torch is recommended. The collapsible tubes are of such size as to be readily carried about in the pocket, and as they have a pointed screw top the material is easily applied without wasting. The replacement of the cap makes evaporation of the flux impossible, thus keeping the compound in its plastic or pasty condition.

STARTING SWITCH FOR INDUCTION MOTORS.

The accompanying illustrations show a switch for controlling induction motors put on the market by the Midland Electric Manufacturing Company, Midland, Mich. The device is applicable for motors rated as high as 10 hp. In its first position the switch places in circuit fuses heavy enough to protect the motor at starting, and in its final position fuses of smaller rating are in circuit to protect the motor against any possible overload in operation. The switch is first moved forward to the position shown in Fig. 1, which places into circuit the larger fuses located at the entrance of the building at the meter loop, or in a large installation at the distribution panels. A further push places the switch in the running position, as shown in Fig. 2. The switch blade proper has now passed out of contact and the circuit is formed through the smaller fuses mounted above the blades of the switch. When stopping the motor the switch is pulled out of contact just as an ordinary knife switch. A feature to which the manufacturer draws

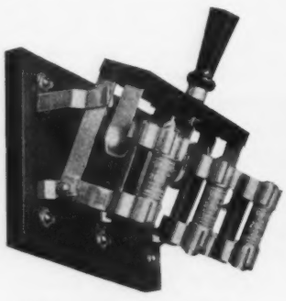


Fig. 1—Starting Switch in Starting Position.

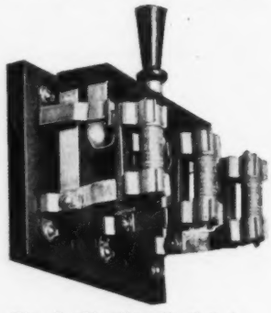
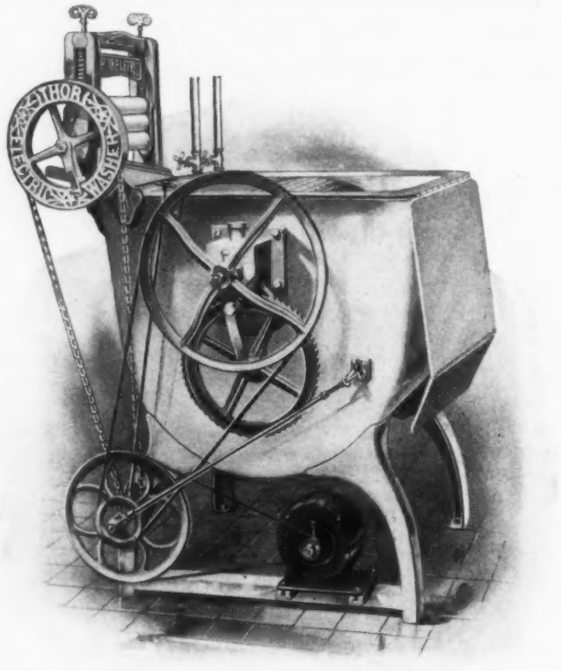


Fig. 2—Starting Switch in Running Position.

attention is that there is no appreciable interruption of the circuit in changing from the starting to the running positions, since the blade of the switch and the contact member of the fuse are so close together that one or the other is in contact during the operation, thus preventing any tendency to arcing.

STATIONARY ELECTRIC LAUNDRY MACHINE.

To meet the demand of architects and owners of homes for a permanent stationary electric laundry machine, the Hurley Machine Company, of Chicago, has devised the machine known as the Thor Electric No. 3 and shown in the accompanying illustration. The body of this machine is made of solid porcelain or white enameled cast iron. It is fitted with a wooden cylinder in which the clothes are washed, and which is arranged to make several revolutions in one direction and then reverse



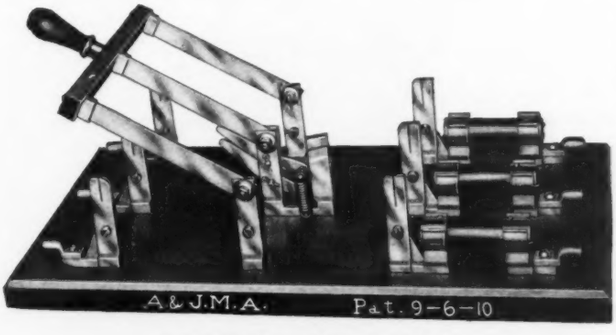
Electric Laundry Machine.

automatically. A ¼-hp Westinghouse electric motor furnishes the power to operate the washer and also a three-roll reversible wringer which is attached to the body of the machine. The principle of the automatically reversing washing machine is covered by patent, and the reversible wringer is also patented.

All mechanisms are made of bronze, nickel-plated, with the exception of the reversing gears. The cover of the machine is of highly polished German silver, and nickel-plated brass connections for hot and cold water are fitted to the machines. The drain is provided with a standard brass flange coupling which may be easily connected to the regular laundry tub drain. The machine presents a notably clean and attractive appearance, and is designed for permanent use in the better class of residences and apartments.

INDUCTION MOTOR-STARTING SWITCH.

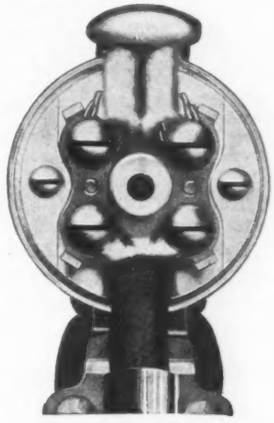
The motor-starting switch illustrated herewith was designed to secure protection of motor and starting compensator without the use of a very complicated mechanism. The most important advantage sought is to prevent the connection of the motor across the mains at full voltage without first connecting it to the compensator. This is accomplished in positive manner by a blade stop, which allows the switch to be thrown to a running position only after it has first been cut into the compensator side. Another important safeguarding feature is that the switch will remain in the compensator clips only so long as it is held there by hand, two powerful springs being used in such a manner that on releasing the handle the switch immediately flies open. This feature is considered important, as a careless operator is liable to leave the switch as soon as he sees the motor running without throwing it over to the running side, which would result in the burning out of the compensator. The over-all dimensions of this type of switch are only slightly greater than those of the standard double-throw switch of like capacity. The designer and manufacturer of this switch, Albert & J. M. Anderson Manufacturing Company, Boston, Mass., is prepared to furnish switches of this type in 25-amp, 50-amp, 75-amp, 100-amp and 150-amp sizes.



Induction Motor-Starting Switch.

TERMINAL BOX IRON.

The Diamond Electric Company, Binghamton, N. Y., has brought out an electric flatiron having a terminal box attached to the rear upright of the handle strap, together with an improved clip for gripping and supporting the cord at the back of the handle. By this arrangement two desired results have been obtained—easy cord renewal and cool connections. This first feature will be greatly appreciated by repair departments of institutions and business houses where a large number of irons are in use. The only connections in this iron are within the terminal box, and those versed in the art know that every hot electrical connection is a seat of trouble. A porcelain block supporting binding screw plates is inclosed in an insulated pressed-metal box located away from the heat of the iron. The removal of one screw frees the cover and exposes the entire box with connections. The cord clip is a pressed-metal bracket so shaped and supported as to allow the cord to leave the iron at a convenient angle and terminates in two diameters, one gripping the cord, the other gripping the protecting spring, a thread being pressed into its inner surface for this purpose. The removal of two screws separates the gripping end and frees both cord and spring. That the ends of the resistance wire, comprising the heating element, shall not conduct heat to the terminal block they are folded back upon themselves and twisted tightly their entire length, thereby greatly decreasing their resistance and producing mechanically strong and cool terminals. These ends are then brought out of the body of the iron and fastened to the binding screw plates on the terminal block, to which are also attached by separate screws the ends of the attaching cord. The parts are in full polished nickel plate and neatly designed, giving the iron an attractive and pleasing appearance.



Terminal Box Attached to Handle of Flatiron.

ELECTRIC TOASTER, STOVE AND GRIDDLE.

In the toaster, stove and griddle manufactured by the Pelouze Electric Heater Company, Chicago, the principle known as "radiant suspension" of applying heat is employed, the object being to utilize radiant heat with the greatest possible speed and with the smallest loss. By suspending the conductors in the air above a proper reflector these results are said to be obtained, but not without mechanical difficulties. As the conductor expands rapidly under the influence of the heat, tension devices must be provided to take up the slack in order to avoid short-circuits. This difficulty has been overcome in the apparatus illustrated herewith. The power consumption of the toaster, stove and griddle is said to be 450 watts. The device is said to be capable of toasting the first piece of bread in fifty seconds and each piece thereafter in forty-five seconds. The heating element is complete in one piece with the contacts and is supported from underneath by one screw. Moreover, the elements are interchangeable. Being of the horizontal type, it

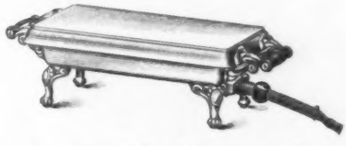


Fig. 1—Toaster Used as Griddle.

Fig. 2—Toaster Used as Stove.

is necessary to collect crumbs, or otherwise there would be objectionable smoking. In the toaster under discussion there is a nickel-plated tray, removable from one end, provided for this purpose. The stove attachment, or chafing dish, used in connection with the toaster provides a practical, useful cooking device, combining successfully an efficient toaster, stove and griddle. The toaster includes also an upper rack provided for

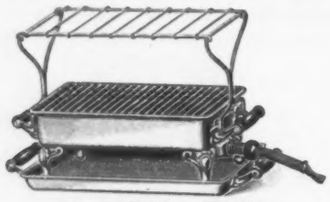
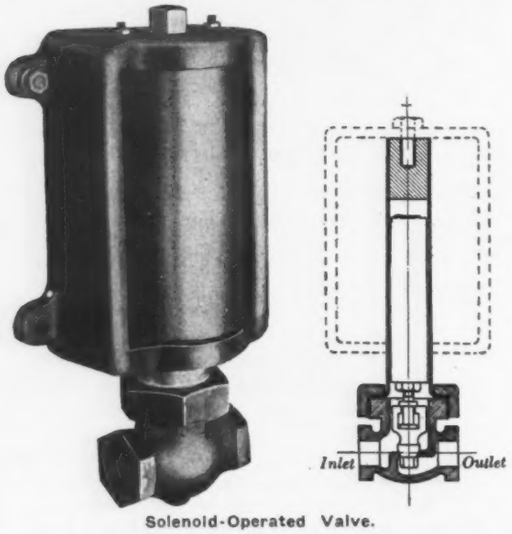


Fig. 3—Pelouze Toaster.

keeping the toast heated, or to act as a plate warmer. This rack may be removed when the toaster is used as a chafing dish or griddle. A feature of the Pelouze devices is a quick break-switch block. The operator grasps a ball attached to a tempered spring, which permits of a jump or quick break, thus avoiding arcing or contact troubles.

SOLENOID-OPERATED VALVE.

A very interesting and uncommon solenoid application is employed in a device just developed by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. This is a solenoid-operated valve shown in its final design in the accompanying illustration. The construction employed permits of the placing of the plunger inside the piping system and entirely eliminates stuffing-box frictions. The energizing of the coil lifts the solenoid plunger through a short, free travel, unseating the valve by a hammer blow. After the valve is started the pressure becomes nearly balanced. The coil circuit can be run wherever desired so that the valve can be operated from any location or series of locations according to the arrangement. These devices find many uses in hydraulic or pneumatic systems, with self-starters, for remote control of valves used for setting the brakes in a pneumatic brake-control system, etc. When arranged with a thermostat in a heating system they



Solenoid-Operated Valve.

can be made to control automatically the flow of steam as desired. In signal systems where air-operated whistles are used these valves save piping and enable the ready control from a central location. In garages the air in compression tanks used for inflation of tires can be controlled by these devices with operating switches placed where convenient. The employment of this device as air unloader in connection with a double-acting compressor relieves the difficulty found in starting under compression. The arrangement consists of a by-pass automatically operated by the valve which permits the pressure to be released from the cylinder (preventing compression) until the desired speed has been reached, when this by-pass is automatically closed, loading the compressor. The valves are built in four standard sizes—⅜ in., ½ in., ¾ in. and 1 in., threaded for standard iron pipe and having an area of opening approximately equal to that of pipe of same rated size. The standard coils are wound for voltages of 115, 230 and 500.

WESTINGHOUSE BANQUET.

On Saturday evening, March 11, the Fort Pitt Hotel, Pittsburgh, was the scene of a banquet attended by nearly 450 men representing the Westinghouse interests in the vicinity of Pittsburgh. The banquet was held under the auspices of the Westinghouse Club, which draws its members from these interests, which include: The Westinghouse Electric & Manufacturing Company, the Westinghouse Machine Company, the Westinghouse Air Brake Company, the Union Switch & Signal Company, the Nernst Lamp Company and one or two other subsidiary companies.

The object of the gathering was to promote a feeling of good fellowship and afford a means for social intercourse among the employees of the various establishments.

Mr. E. M. Herr, vice-president and general manager of the Electric company, was toastmaser. Before introducing the speakers he gave a brief history of the Westinghouse Club, its purpose and its wonderfully increased activities of late, its membership having increased 150 per cent in the last six months. The first speaker was Mr. L. A. Osborne, who responded to the toast "A Young Man's Outlook," and told of the wonderful opportunities of a young man and also of his responsibilities.

Mr. F. R. Babcock, president of the Pittsburgh Chamber of Commerce, spoke in an interesting manner of Pittsburgh and the Westinghouse industries, telling what a tremendous factor these industries have proved in the rapid growth of the greatest machinery-making city in the world.

Mr. C. A. Terry, of New York City, first vice-president of the Electric company, spoke of "Ye Olden Times" and in a most instructive and illustrative address told of the early struggles of Mr. George Westinghouse and traced briefly the manufacture of electrical apparatus from the early days down to the present time. He took occasion to advise the young men before him to master thoroughly all engineering details and devote themselves by close and energetic application to their respective duties.

Mr. H. T. Herr, general manager of the Westinghouse Machine Company, spoke on "Prime Movers," giving brief accounts of some of those who have helped the Westinghouse industries attain their prominence in the industrial world.

"Short Stops" was the subject assigned to Mr. W. V. Turner, chief engineer of the Air Brake Company. Mr. Turner related briefly the history of the development of the air brake by Mr. Westinghouse. He also spoke of the young men and their opportunities, stating that "Short Stops" by older heads were often necessary to prevent the young man's enthusiasm carrying him too far.

Mr. H. E. Longwell, consulting engineer of the Machine company, proved to be the humorist of the evening and in discussing "Perplexities" soon had his audience highly amused by his witty remarks.

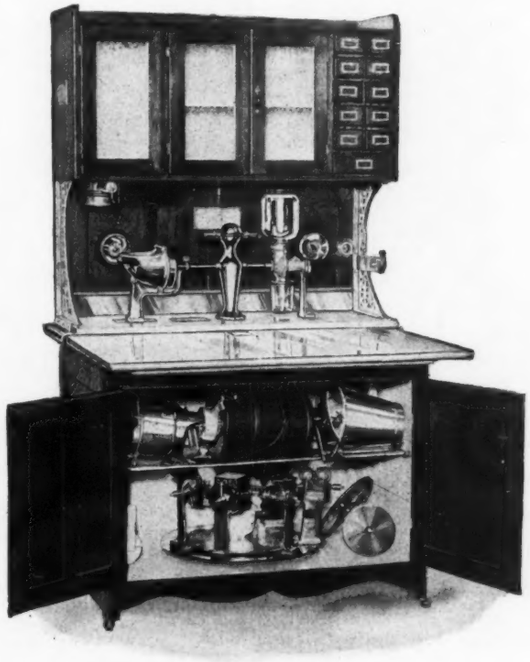
"Resonance" was assigned to Mr. J. J. Jackson, of the legal department of the Electric company, and the speaker, at the beginning of his remarks, confessed his ignorance of such a technical subject and his chagrin at having had such a subject assigned him. His hearers, however, soon felt that the legal mind really was quite well versed in the meaning of resonance, as he neatly turned it into a plea for co-operation between fellow workers, producing harmony all along the line.

Mr. Walter G. Cary, manager of the Westinghouse Lamp Company, Bloomfield, N. J., in a few well-chosen, happy remarks concluded the speaking with an address on "The Brighter Side of Life."

The banquet proved to be such a great success that steps will be taken to make it an annual event.

ELECTRIC KITCHEN CABINET.

Domestic applications of electrical energy have brought many conveniences in their train, but perhaps the most compact and elaborate combination of electrically operated culinary devices is the electric kitchen cabinet made by the Federal Electric Company, Chicago, and shown in the accompanying illustration. In the base of the cabinet is a ⅛-hp electric motor connected to a shaft-head on the table bed, where the two ends of the shaft are available for connection to various appliances. The motor is placed in a separate compartment where it cannot be tampered with or cause injury to persons unfamiliar with the use of machinery. It is controlled by a conveniently placed switch on the inside of the back wall of the cabinet. The



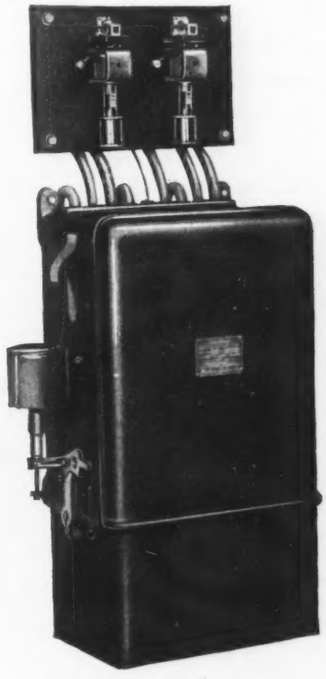
Electric Kitchen Cabinet.

revolving ends of the shaft arms are protected by swivel collars so that the clothing or fingers of the user will not be caught even when the devices are operated at full speed. Furthermore, all gears on the various pieces are protected by guards to prevent accident. In addition to the mechanical features the cabinet serves the purpose of the ordinary kitchen cupboard in the various operations of preparing food for cooking or for the table. Eleven distinct appliances make up the complete equipment of this cabinet. When not in use they are kept on the racks in the lower part of the cabinet. These attachments consist of a bread mixer, a cake mixer, an egg beater, a vegetable slicer, a coffee grinder, a meat cutter, a potato or lemon grater, a cherry pitter, a knife sharpener, a knife polisher and an ice-cream freezer. A special extension shaft is provided to operate a pulley at the right-hand side of the cabinet, to which the ice-cream freezer or even a sewing machine or other household device may be belted.

The various utensils are provided with a standard base with beveled edges, this base fitting into the grooved channel under either power arm. The piece to be used is slipped into the groove up against the power shaft and clamped in place by a lever at the front of the grooved channel. Any piece can be put on or taken off without stopping the motor and two utensils can be operated at the same time. Excepting the wooden tub of the freezer all appliances are nickel-plated and easily taken apart for cleaning. The cabinet is made of oak, in golden oak finish, and stands 5 ft. 10 in. high, occupying a floor space of 30 in. x 44 in. It is mounted on casters. An attachment cord with standard-base plug is provided for connecting the motor to any convenient socket. The upper part of the cabinet is divided into compartments for flour, tea, coffee, sugar, spices, etc. This cabinet is particularly adapted for use in hotels, restaurants or boarding houses, where it is said that it will save its cost in a year's time by reducing the cost of labor in the kitchen.

AUTO-STARTERS FOR INDUCTION MOTORS.

A line of alternating-current starting devices for use with squirrel-cage induction motors, and known as the auto-starter, has just been placed on the market by the Wesern Electric Company. The line has for its features a no-voltage release,



Auto-Transformer Starter for Induction Motors.

relay protection from overloads and a foolproof switch. They are made for standard two-phase and three-phase circuits, and in both wall suspension and floor types. The core and windings, the cable clamp and switch are assembled in a substantial iron case. Each phase is provided with an inductive winding on separate legs of a laminated core, each winding being provided with several taps in order that the auto-starter can be adjusted to individual starting requirements. As all parts are readily accessible these taps can be easily changed. Perhaps the most important feature of this auto-starter is the foolproof switch. This switch, which is oil-immersed, is located at the bottom of the case, which arrangement permits of the removal of the inclosing oil tank for inspection or removal of the oil or contacts without taking the auto-starter from its mounting or disconnecting any of the leads. The current-carrying parts of the switch are of the railway-controller type, the contacts being of heavy copper. To keep the attendant from throwing the motor directly on the line instead of going first to the starting position, an automatic latch is provided, so arranged that the lever at "off" position can be thrown into

the "starting" position only. This latch also prevents going from "starting" to "running" in any manner save with a quick jerk, thereby avoiding any appreciable drop in the speed of the motor and a consequent increase in current while passing between the two latter positions. A no-voltage release, consisting of an ironclad solenoid with a movable core, shunted across the line is a simple device which opens the starter switch when the voltage drops below an allowable low-voltage value for which the release is set. This causes the starter switch to return to the "off" position and disconnects the motor from the circuit.

The auto-transformer starters are provided with a flat fuse block on which are mounted cartridge-type fuses separated by barriers. These fuses are connected on the running side of the starter circuit, and are not in circuit when the auto-starter switch is in the "starting" position. If preferred, an overload-release panel can be substituted. The overload release consists of two solenoids with movable cores which at a predetermined value of line current pick up and open-circuit the no-voltage release coil, which in turn causes the switch to return to the "off" position. The use of these relays also prevents the motor from running on single-phase, for the increased load due to the motor running on single phase will cause the relay to trip and return the switch to the "off" position.

MERCURY-ARC RECTIFIERS FOR MOTION PICTURES.

One of the most important factors contributing to the success of a motion-picture theater is the quality and brilliancy of the light projected from the lamps. For pleasing effect motion pictures require a steady, white light of sufficient intensity to bring out the natural light and color values of the films, and the theater having the best quality of light stands the best show of getting the biggest patronage. It is well known that the light obtained from direct current is much superior to that from alternating-current arc lamps. However, until recently all those who could obtain only alternating-current supply have got along with the poorer quality of light simply for the lack of apparatus for economically converting alternating current into direct current.

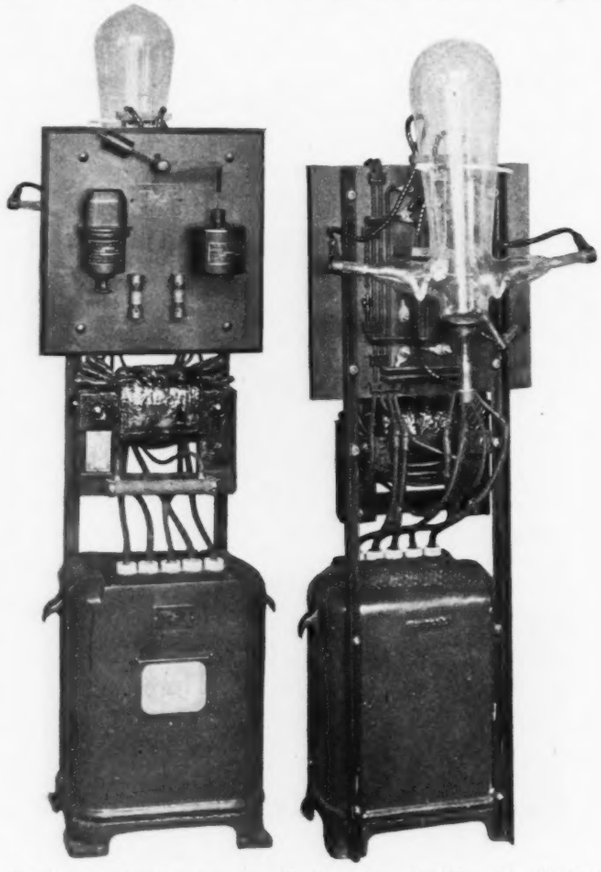
In the accompanying illustrations is shown a mercury-arc rectifier developed by the General Electric Company for furnishing current of the desired character at a cost less than that of the most economically operated alternating-current arc lamp.

There are certain facts which should be borne in mind while making an analysis of the cost of producing a given intensity of projected light from alternating current, direct current and rectified current with the most approved devices applicable in each case. For instance, the best class of motion pictures require a light intensity of upward of 8000 cp, and as 5000 cp is the maximum obtainable from alternating current with the best auto-transformers or the highest current values practicable, it is evident that the use of alternating current under such conditions is entirely unsatisfactory owing to the insufficiency of the light. Where direct-current supply is obtainable some have found relief by using it, but their experience has served to emphasize the prohibitory effect of the additional cost entailed by the loss of at least 60 per cent of the energy drawn from the line in the resistance or rheostat employed to regulate the current in the arc.

These facts serve to define the limitations of both the alternating-current and the direct-current arc relative to motion-picture lighting, but in order to give the various alternating-current methods a fair basis for comparison, assume that a light intensity of 5000 cp is required. From actual determinations carefully made it is found that to obtain 5000 cp from a 110-volt alternating-current circuit with rheostat requires 7 kw; a 110-volt direct-current circuit with rheostat requires 2.25 kw.; any alternating-current circuit with auto-transformer requires 2.1 kw; any alternating-current circuit with mercury-arc rectifier requires 1.7 kw.

Since auto-transformers are extensively used in alternating-current supply systems to obtain a substantial reduction in energy consumption, the method of using alternating current with rheostats may be considered as obsolete, and since a prohibitory amount of energy is wasted in using direct current with a rheostat that method also can be omitted from present consideration. This fact enables a direct comparison to be made between the results obtained from alternating current with the use of economizers on the one hand and mercury-arc rectifiers on the other.

The figures given above show a difference of 400 watts in favor of the mercury-arc rectifier. This means that on the basis of an average daily run of seven hours at a cost of 6



Front and Back Views of Mercury-Arc Rectifier for Moving Picture Machine.

cents a kw-hour the use of a mercury-arc rectifier provides a light having all the advantages of that given by a direct-current arc at a cost at least $60 per year less than that obtained from alternating current with the best type of auto-transformer.

Furthermore, it is evident that when the light intensity required exceeds 5000 cp, thus rendering the alternating-current method inapplicable, the saving effected by the use of the mercury-arc rectifier as compared to the cost of using direct current with a rheostat is much more significant. For instance, to obtain 7500 cp requires 3.1 kw from direct current with rheostat and 2.15 kw from alternating current with mercury-arc rectifier. The difference in favor of the mercury-arc rectifier is 950 watts, which means a saving of at least $145 per year.

In addition to the positive money-saving capability of the device the excellent light of practically any candle-power obtainable from alternating-current supply and the reliability, ease and safety of operation render the mercury-arc rectifier particularly desirable for making pleasing and successful "photo plays."

Industrial and Commercial News

THE WEEK IN TRADE.

NUMEROUS buyers have been present in the principal distributing markets during the past week, which has produced a moderate degree of improvement in the house trade done by wholesalers and jobbers. There has been apparent during the past week some slight check to the forward movement in the iron and steel industry. This is attributed principally to the uncertainties engendered by the calling of an extra session of Congress and to the general feeling of apprehension developed by the disturbances along the Mexican border. It is not, as a rule, believed that the passage of the reciprocity agreement with Canada will seriously affect our iron and steel mills. It is known that the Canadian plants are well supplied with orders, and it is hoped that with reciprocity there may come a considerable demand upon the mills of this country from the Dominion. Our own railroads, however, are still buying material along very conservative lines—in fact, are only filling insistent requirements. Special machinery is in very light demand and at many points hundreds of skilled mechanics are out of employment. Wire products have been advanced $1 per ton, and this branch of the industry is being operated at almost full capacity. Building operations have not as yet become as active as was hoped for, although better reports are anticipated as the weather grows more favorable. Collections are reported as being only from fair to slow. Failures for the week ended March 9, as reported by *Bradstreet's*, were 230, as compared with 256 the previous week, 250 in the same week of 1910, 254 in 1909, 278 in 1908 and 186 in 1907.

THE COPPER MARKET.

KEEN competition for business among the large wire-drawers of the country made a very much better demand for copper last week than the ordinary market has experienced in recent months. While sales were not large, and there will be no records made, manufacturers from all parts of the country seemed eager to lay in limited stocks. It seems apparent that the demand for copper wire is extending, and this speaks well, of course, for the general electrical industry. It is stated that owing to this competition among manufacturing interests the sales of bare copper wire and cable strands have been made in recent weeks at very close to the cost of manufacture. Such prices have brought out numerous inquiries from traction and lighting companies all over the country, and manufacturers are preparing themselves for prospective orders. Most of the sales made last week were in lots of 1,000,000 lb. or more at 12¼ cents delivered for electrolytic. On the other hand, the demand for casting and other grades of copper is comparatively dull. The majority of the recent sales have been made by independents, the Amalgamated apparently not caring to reach the lower level of prices. The report of the Copper Producers' Association for February, which was made public last week, shows an increase in the surplus stock of copper amounting to 14,198,280 lb. The production was 109,828,297 lb., as compared with a production of 115,696,591 lb. in January, but the decline was entirely due to the fewer number of working days in February. The rate per day was higher. Domestic deliveries were 50,518,998 lb., an increase of more than 8,000,000 lb. over the previous month, and exports were 45,111,019 lb., a decrease of about 8,000,000 lb. For the two months the total deliveries were almost at the same figure. The surplus at the end of February amounted to 156,637,770 lb. Exports last week were fairly active. The total for March, up to and including March 13, was 10,547 tons. The daily call on the Metal Exchange March 13 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.85	11.95	.....
March	11.85	11.95	11.90
April	11.85	11.95	11.90
May	11.85	11.95	11.90
June	11.85	11.95	11.90

The London market, March 13, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	55 1 3	54 16 3
Standard copper, futures	15 15 0	55 10 0

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.30c	11.87½c
London, spot	£56 15 0	£53 15 0
London, futures	57 12 6	54 10 0
Best selected	60 5 0	58 0 0

INDUSTRIAL AND COMMERCIAL NOTES.

American Gas & Electric Company.—The American Gas & Electric Company has set apart $3,000,000 to be spent this year upon improvements to its various properties. Of this amount $1,000,000 will be spent in improving the generating plants and transmission lines of the Scranton Electric Company. For this company the generating station known as the "suburban plant," which is located just outside of Scranton at Green Ridge, will be practically rebuilt. At this plant a new 5000-kw turbo-generator set and a 1700-kw engine-driven unit will be installed. This will give the plant a total capacity of about 12,000 kw. This apparatus has been purchased from the General Electric Company. The power house will be largely rebuilt and considerable will be expended upon fireproofing the building. A large electric crane will also be installed. This will be the principal power plant of the company, although the station known as the Lackawanna River station will largely attend to the lighting business of Scranton. At this latter station a new 2000-kw engine-driven set will be installed. A large steam main will be constructed from the suburban station for the heating department of the company. Four stations which belonged to companies absorbed by the Scranton Electric Company when it was formed in 1907 will be turned into substations. They are known as the Dix Court, Jefferson Avenue, Ridge Road and Carbondale stations. A high-tension transmission line from the Green Ridge station to Forest City will be constructed, where energy will be transmitted at 23,000 volts. In addition to this, the Scranton Electric Company will construct a tie line with the 10,000-kw station of the Delaware, Lackawanna & Western Railroad, in the nature of an emergency service. The American Gas & Electric Company has also ordered for the Wheeling (W. Va.) Electrical Company a 10,000-kw General Electric turbo-generator set, and it has drawn plans for adding to the Canton (Ohio) Electric Company a 6000-kw generating set. It will also construct a new building for this plant. In addition to these outlays, quite a number of small transmission lines will be constructed and a considerable amount of small apparatus has been ordered.

Electric Heat Storage Company.—The Electric Heat Storage Company, which was organized Nov. 15, 1910, under the laws of New York for the purpose of acquiring the patents and other rights to manufacture and sell electrical apparatus and devices under the "Therol" system in the United States, has opened offices at 165 Broadway, New York. The capitalization of the company is $1,500,000. William C. Hall is president. It is the purpose of this company to manufacture and sell electric cooking ranges and hot-water heaters and other domestic appliances employing the "Therol" system of heat storage, and also to develop heating systems for residences, factories, cars, etc. The features of this system were fully described in the issues of the *Electrical World* of Sept. 30 and Nov. 18, 1909. Speaking of the outlook for the company, President Hall said: "We believe that the field for the employment of this principle is very large in this country, and that the co-operation of electric generating companies is insured by the increased consumption of current at hours when their plant is otherwise not being employed, and that the consumer will give a ready welcome to all household appliances which furnish heat for useful purposes and without the accompanying disadvantages of unnecessary radiation. We will soon be ready to furnish prices and accept orders."

Trade Catalogues Wanted.—The Wilmington Institute Free Library, in extending its department of applied science, will add a department of trade catalogues, and desires to be placed on the mailing list of manufacturers of electrical and allied apparatus. A. L. Bailey is librarian.

Big Electrical Project of Lehigh Coal Company.—In a full statement authorized by W. A. Lathrop, president of the Lehigh Coal & Navigation Company, the details of an immense electrical project which is to be undertaken by that company have been made public. It is given out in this statement that the plans of the company are to spend $10,000,000 in establishing great power plants at its anthracite mines, and to transmit energy instead of hauling coal. The project has been worked out by the officials of the company in connection with the engineering firm of Lewis B. Stillwell, 100 Broadway, New York. The general idea of the plan is based upon the principle that it is a waste of energy to transport coal in order to generate power, when the power can be generated at the mines and transmitted to any point desired. In addition to this, Mr. Lathrop's statement points out the fact that there is a waste of 500,000 tons of anthracite coal dust every year at the mines of the Lehigh Coal & Navigation Company. It was the desire to use this unmarketable product that first caused the company to employ engineers to make the scientific investigation. The coal dust will be used either in special fire boxes which are being experimented with or by molding it into briquettes. The first power plant which it is contemplated to build will be located ten miles west of Mauch Chunk at a town called Hauto. This is right at the mouth of a tunnel leading from the main body of anthracite coal owned by the company. The location is also selected because of an abundant supply of water, which will be impounded by the construction of a dam, forming a reservoir with a capacity of more than one billion gallons. The initial power plant will have a capacity of 20,000 kw. To insure this three generating units of 10,000 kw each will be installed. Gradually it is expected to enlarge the plant to 100,000-kw capacity. To run such a plant, it is estimated, will require 1,000,000 tons of coal a year, a quantity of anthracite which, it is pointed out, would require 20,000 of the largest freight cars to transport to market. The company contemplates the expenditure of $3,000,000 at first, and eventually $10,000,000. Within a year the Navigation company management expects to have the first section of the Hauto plant in operation. The plant is to supply energy first to the cement and slate industries in Lehigh and Northampton counties, in Pennsylvania. These are in a territory from twenty to forty miles from the proposed plant. A complete power census of the district has been made, and the exact amount of power these industries require and also their expenses of manufacture are known. In this one district more than 100,000 hp is now being used. Knowing these facts, the company has made a schedule of prices which will deliver energy quite materially under the cost at which these industries can produce and at a figure which will yield it a considerable profit. These prices run from 8 mills per kw-hour up to 2½ cents, according to the amount contracted for and how steadily it will be used. From the Hauto plant alternating current of very high voltage will be carried by transmission lines to four substations at Slatington, Nazareth, Bath and Bangor, where it will be stepped down for distribution. The transmission lines will be constructed largely along the Lehigh Navigation canal and on the right-of-way controlled by the Lehigh & New England Railroad. Mr. Lathrop began investigating the commercial merits of this project in 1908. Since then a thorough investigation has been made along both commercial and engineering lines. The officers of the company are entirely satisfied with the practicability of the plan. It is expected ultimately to carry the energy to Allentown and Easton, Pa., and Trenton, N. J., and it may be possible also to reach Philadelphia. As the right of an electric company operating with steam to distribute energy is, under the laws of Pennsylvania, confined to a single township, it will require a large number of small companies to enable the large central power plant to reach the industrial centers as contemplated.

Recent Bids for Alternator, Transformers and Cables.—Bids were opened by the trustees of the Sanitary District of Chicago (operating the Chicago Drainage Canal with its hydro-electric plant) on March 9 for an alternating-current generator and rheostat, six transformers and lead-covered undergound cables. This apparatus is needed for an additional generating unit at the Lockport (Ill.) power house and for corresponding extensions. The generator to be furnished and installed is of the water-wheel type capable of delivering 4000 kw with a power factor of 85 per cent at a normal speed of 164 r.p.m. The effective voltage is 6600, three-phase, 60-cycle. A suitable motor-operated field rheostat is included in the specification. Two bids were received. One, from the W. A. Jackson Company, of Chicago, is $24,443. This, no doubt, contemplates a General Electric machine. The other, from the Crocker-Wheeler Company, is $24,900. The existing generators are of the Crocker-Wheeler type. Three single-phase step-up transformers and three single-phase step-down transformers are specified. The former are to be placed in the Lockport power house to operate on 60-cycle current, and the bank of three must have a capacity of 4600 kva. The secondard voltages shall be 44,000 and 41,800; the primary voltage shall be 6600. The transformers are to be of the oil-immersed, water-cooled type. The three step-down transformers are of the same type and must transform voltages of 40,000 and 38,000 volts to 13,200, 12,000, 9000 and 6600 volts. They are to be installed at the Western Avenue terminal station in Chicago. The five bids received are as follows: Westinghouse Electric & Manufacturing Company, $15,800; Crocker-Wheeler Company, $16,000; Moloney Electric Company, $17,000; W. A. Jackson Company, $17,492; Wagner Electric Manufacturing Company, $18,400. In every case except that of the Jackson company the proposal was accompanied by explanatory letters, drawings or specifications. The lead-covered cables required are to be placed in underground conduits to transmit 60-cycle, three-phase alternating current and for single-phase series arc service. Various sizes and voltages were specified and prices per foot were asked. Manufacturers were required to furnish a sworn statement that 30 per cent of pure Para rubber had been placed in the rubber compound used. The exact amount of each size of cable required was not specified, the Sanitary District reserving the right to order as required within six months from date of contact. Five concerns made bids. For varnished-cloth cable having three conductors of No. 6 B. & S. gage, designed for operating voltage of 12,000, with varnished-cloth wall of 7/16 in., rubber wall of 7/64 in., insulating jacket of 3/16 in. of varnished cloth and lead covering of ⅛ in. (to enumerate one size only), the proposals were as follows: Waterbury Company, 67.4 cents per foot; American Steel & Wire Company, 66.38 cents; Standard Underground Cable Company, 66.62 cents. For rubber-covered cable having eight No. 6 conductors, operating voltage of 7000, thickness of wall of ⅛ in., insulation jacket of ⅛ in. and lead covering of ⅛ in. (to enumerate only one size here, also) these bids were received: Waterbury Company, $1.23 per foot; American Steel & Wire Company, 99 cents; Standard Underground Cable Company, $1.327; Safety Insulated Wire & Cable Company, $1.67; Simplex Electrical Company, $1.386.

Electrically Operated Flour Mills in Louisville.—According to *Chained Lightning*, the organ of the Louisville (Ky.) Lighting Company, the majority of the up-to-date flour-milling concerns in Louisville use electric drive, the motors being operated by energy furnished by the Louisville Lighting Company. It is asserted that the product of flour mills is much better where electric drive is used, this fact being accounted for by the evenness and regularity with which the machinery is driven when operated by electric motors. Another advantage of the use of electric energy is that the grain elevators can be operated at any time, say on Sunday, irrespective of the rest of the plant, as it sometimes happens that it is desired to store or handle grains at times when the rest of the plant is not running.

Westinghouse Foreign Orders.—The Rio de Janeiro Tramway, Light & Power Company has placed an order with the Westinghouse Electric & Manufacturing Company for a duplication of the equipment purchased about a year ago, which consisted of a 2000-kw motor-generaor set. Walter Brothers & Company, of Rio de Janeiro, Brazil, have just placed an order with the same company for one 110-kw and one 100-kw, three-phase, 60-cycle, 11,000/2200-volt transformer, and one 110-kw, three-phase, 60-cycle, 2400-volt, 900-r.p.m. water-wheel type generator.

Extension of Time Limit of Contracts.—The time limit of the contract of the City of Chicago with the National Carbon Company for the delivery of arc-lamp carbons to the city, dated April 15, 1910, has been extended for ninety days from Dec. 31, 1910. The time limit of the contract with the Western Electric Company for furnishing arc-lamp globes, material and supplies, dated Feb. 17, 1910, has been extended likewise ninety days from Dec. 31, 1910.

Crocker-Wheeler Company Sales.—Twelve carloads of dynamos, motor and other apparatus were recently shipped in one special train from the Crocker-Wheeler Company to the United States Steel Corporation's plant at Gary, Ind. The shipment weighed over 735,000 lb. and represented a value of almost $250,000. It included almost 6300 hp of motors and 2000 kw in generators. The equipment consisted of a 2000-kw motor-generaor set, the flywheel of which weighed almost forty tons, and four motors of 1200 hp each. This generator will convert the alternating current that is used at the plant of the American Sheet & Tin Plate Company into direct current which will be used, through the four 1200-hp motors, to drive the machinery of two rolling mills. The motors will be operated at the low speed of 21 r.p.m. and will be required to reverse from fourteen revolutions in one direction to the same speed in the other within one second of time. This shipment is in addition to 14,200 hp in motors and 4500 kw in generators heretofore installed by the Crocker-Wheeler Company in the same plant.

Western Electric's Heavy Business.—According to reports given out by the Western Electric Company's officials, the concern has no cause to complain of the first two months of 1911. Some of the other manufacturing concerns have reported a smaller volume of orders than for the same months in 1910. Not so with the Western Electric. Its February business was not only 20 per cent greater than for the same month of 1910, but constituted a new high record for February. The rate of orders for January and February indicates a total business for the year 1911 of approximately $71,000,000, which will be in excess of even the highest record of the company, made in 1906, when the sales amounted to $69,000,000. The total sales last year were $61,000,000 and in 1909 were $46,000,000. Favorable weather and crop conditions in the West and South indicate that the demand for telephone equipment from the agricultural districts will be particularly heavy this season and the company is fully prepared to meet any demand that will be made.

Platinum at Top Price.—Platinum has advanced very rapidly within the last few weeks, and is now selling in the neighborhood of $45 an oz. This is the highest price at which the material has ever been sold. There seems to be no explanation forthcoming as to the sudden advance, and it cannot be attributed entirely to the demand. Although there has been a satisfactory demand for platinum, much better indeed than last year, it is not such as to warrant this enormous increase in price. In the fall of 1908 platinum could be purchased in this market at $19 an oz. That period marked the low level of recent years. If there has been any manipulation of the market by Russian bankers, who practically control the output of the world, it has not been made plain to the New York dealers.

Westinghouse Gas Engines and Producers.—The Roswell Gas & Electric Company of Roswell, N. M., has just placed a large order for gas engines and producers with the Westinghouse Machine Company. The new equipment includes three single-crank gas engines, of capacities 300, 715, 113 hp respectively. The six gas producers are of the Westinghouse type W and will have a capacity of 250 hp each. Three generators will be supplied by the Westinghouse Electric & Manufacturing Company, having capacities of 600, 250 and 100-kw each, and will generate 2300-volt, three-phase, 60-cycle energy. The new equipment will be used in lighting and power service.

Chicago Electrification.—It is said that the railroads of Chicago have practically concluded that the electrification of their terminals is bound to come, and have already tentatively drawn plans for a new system of freight-distributing yards on the outskirts which will be the greatest freight-handling system in the world. A. S. Baldwin, chief engineer of the Illinois Central, says that while such a plan is being considered it is not entirely with the idea that the roads will be forced to electrify. Such yards would be of great advantage under any circumstances, but would be almost necessary in the case of electrification.

Electricity for the Snead Power Building in Louisville.—The new Snead Power Building in Louisville is designed to furnish quarters for a large number of tenants engaged in small manufacturing enterprises. The building has a frontage of 184 ft. and is 90 ft. deep and consists of eight stories and a basement. Ample provision for natural lighting is made, the front of the building being a mass of windows. Electricity for lighting and for the operation of electric motors for the building service, as well as for the use of tenants, is supplied by the Louisville Lighting Company.

Pittsburgh Electrical Contractors.—The electrical contractors and fixture houses of the Pittsburgh district on March 8 formed a permanent organization under the name of the Electrical Contractors' Association of Allegheny County, with the following officers: President, H. M. Raphael, Raphael Electric Company; Secretary, R. N. Young, Craig Electric Company; Treasurer, James L. Thompson, James L. Thompson Company. A charter will be applied for and permanent quarters secured.

New Fire-Alarm Equipment for Chicago.—On recommendation of City Electrician Carroll, the committee on finance of the Chicago City Council has recommended that the bid of the Western Electric Company of $1,328.50 for lead-covered cables for use in connection with the fire-alarm office in the new City Hall be accepted; also the bid of the Holtzer-Cabot Electric Company of $1,628.88 for sixty-six dynamos for the same purpose.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Mayville, Ky.; Brunswick, Ga.; Graham, Va.; Cincinnati, Ohio; Sandpoint, Idaho; Crystal City, Tex.; Alvin, Tex.; Fulton, Ill.; Mission, Tex.; Terre Haute, Ind.; Scranton, Pa.; Greenville, Ohio; Yowell, Ky.; Logansport, Ind.; Raymondville, Tex., and Webster, Ia.

Westinghouse Turbo-Generators.—The Oliver Chilled Plow Company, South Bend, Ind., has just placed an order for two Westinghouse turbo-generators. One of the units will have a capacity of 750-kw and the other a capacity of 1125-kw; 440-volt, three-phase, 60-cycle energy will be generated. The turbines will take steam at 150 lb. and exhaust into a vacuum of 27 in. to 28 in.

Financial.

THE WEEK IN WALL STREET

WITHOUT any semblance of activity the stock market maintained prices very firmly last week. Trading was at about low ebb, there being only 1,172,864 shares sold. The more sanguine element of the street points to the fact that the stock market has withstood the adverse decision in the rate case, the calling of an extra session of Congress at which the revision of the tariff will be considered, and the mobilization of the army on the Mexican border without any serious break. The truth of the matter is that there is not enough activity in the market for any serious break to be caused, and there stands ready at all times a powerful syndicate of financial interests to see that no break becomes dangerous. Prices, as a rule, at the close of last week were fractionally lower than at the close of the week previous. In no instance was there any notable advance. The bond market is

NEW YORK.

	Mar. 6.	Mar. 13.	Shares Sold.		Mar. 6.	Mar. 13.	Shares Sold.
Al. Ch.....	7¾*	7⅞*	——	Int. Met., pf.	52¼	51½*	3,184
All. Ch., pf..	30½	30½*	500	Mackay Cos..	91⅞	93½*	500
Amal. Cop...	62½	63⅛	22,225	Mackay C., pf	76¾	75⅞	700
Am. D. T...	20½*	20½*	——	Man. Elev...	139	138½*	250
Am. Loco...	37½	38⅝	900	Met. St. Ry.	15*	15*	——
Am. Loco.pf.	109¾*	109¾*	——	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & C.	84½*	81*	100	Steel, com...	76⅛	76⅞	225,700
Am. T. & T..	144¾	145	3,522	Steel, pfd...	119	118½	3,205
B. R. T.....	78	76¾	4,700	W. U. T....	73	72¼*	1,800
Gen. Elec....	149	149	1,010	West'h, com..	69⅝*	67*	1,400
Int. Met.....	18⅜	18⅜	1,840	West'h, pfd..	117½	120*	300

PHILADELPHIA.

	Mar. 6.	Mar. 13.		Mar. 6.	Mar. 13.
Am. Rys.....	43¾	43½*	Phila. Elec.....	16⅛	16¼
Elec. Co. of A.....	12⅛*	12⅛*	Phila. R. T.....	20½	19⅝
Elec. St. B'ty.....	53¾	54¼	Phila. Trac.....	85½	86½*
E. S. B'ty., pfd....	30*	30*	Union Trac.....	47½	47⅜

CHICAGO.

	Mar. 6.	Mar. 13.		Mar. 6.	Mar. 13.
Chi. City Ry.....	190	185	Chi. Tel. Co.....	121	119½*
Chi. Rs., Ser. 1.....	91½	91½*	Met. El. Co.....	22	21½*
Chi. Rs., Ser. 2.....	24½	24½*	Met. El., pfd.....	68	66*
Com. Edison.....	118½	122¾	Nat'l Car.....	118¾*	118½
Chi. Subways.....	4⅜*	5	Nat'l Car, pfd.....	118½	118½*

BOSTON.

	Mar. 6.	Mar. 13.		Mar. 6.	Mar. 13.
Am. T. & T.....	145	144⅞	Mex. Tel.....	4	4
Cum. Tel.....	149*	151¼	Mex. Tel., pfd.....	6	6
Edison E., Ill.....	289½	291	N. E. Tel.....	142	145
Gen. Elec.....	149½	149	W. T. & T.....	20⅞	20*
Mass. E. Ry.....	17*	17*	W. T. & T., pfd....	94½	93
Mass. E. Ry., pfd...	88	88			

*Last price quoted.
Shares sold for week, March 6 to March 11.

satisfactory, although it could hardly be called active. Large banking houses apparently are willing to take every good issue that is offered when there is a fair margin of profit, and as a rule they let it be known shortly after buying an issue of bonds that the outside public has absorbed the entire lot. The money market continues to be very easy, with the banks almost overstocked with cash. The same condition is apparently existing abroad. Quotations for money March 1 were: Call, 2@2½ per cen; 90 days, 2¾@4 per cent. The quotations in the table are those of the close March 13.

Financial Notes.

Detroit Edison Company.—The full pamphlet report of the Detroit Edison Company for the year 1910 has just been issued. Preliminary figures were published last month, but the detailed figures show gross earnings of $3,030,207, an increase of $831,064 over the previous year; net earnings $1,310,083, a gain of $385,518, and surplus $708,383, which was an increase of $295,519. C. W. Wetmore, president of the company, says in his report: "The number of customers increased 28.6 per cent during the year, and the total connected general light and power load was 92,429 kw, an increase of 28.4 per cent for the year. This does not include the loads of customers supplied in bulk, such as the Detroit United Railway, which buys current for the operation of city and interurban car lines, and the Michigan Central Railroad, which buys current for the electric locomotives used in the Detroit River tunnels. Capital charges during the year 1910 for the development of the company's properties amounted to $2,156,803. The largest item of these expenditures was for the extension and additional equipment of Delray power house No. 2."

Northern New York Telephone Merger.—The Friendship Telephone Company of Syracuse, N. Y., a Bell concern, has made an offer to purchase the outstanding stock and bonds of the Rochester Telephone Company, the Rochester, Syracuse & Utica Telephone Company, the Onondaga Independent Telephone Company and the Utica Home Telephone Company, all of which are Independents. These companies control all of the Independent companies in that section of the State. Negotiations looking to this merger have been going on for some time, and in an official statement given out last week by the Friendship company it was announced that the directors of all the Independent companies had indorsed the sale. The statement also says that when the combination is completed the Bell company will have 20,000 additional subscribers and the service will be much more satisfactory. The combined capital of the companies to be taken over is about $3,100,000.

Commonwealth Edison Stock in Demand.—Shares of the Commonwealth Edison Company, of Chicago, sold up to 124 on the Chicago Stock Exchange on March 10. The stock pays 6 per cent, and the price mentioned is probably the highest reached since the organization of the present company, succeeding the Chicago Edison Company, which paid 8 per cent. The newspapers repeat the rumor that the dividend rate may be increased to 7 per cent, and it is also asserted that the proposed merger of the elevated railway companies of Chicago, which has been brought to the front again, will benefit the central station company by increasing, probably, the demand for purchased electrical energy for railway operation. It is interesting to note that the People's Gas Light & Coke Company pays 7 per cent, Chicago Telephone Company 8 per cent, and Chicago City Railway Company 10 per cent.

Western Union Earnings.—The net earnings of the Western Union Telegraph Company for the quarter ended March 31, the month of March being estimated, are given out as $1,470,000, as compared with actual net earnings for the same quarter last year of $1,794,900. Surplus for the quarter is estimated at $289,098, a decrease of $325,127 from last year. The total surplus of the company is now $9,361,969, a decrease during the year of $9,836,753. The company's surplus account was thus heavily reduced by the large amount charged off due to the comprehensive revaluation which was referred to in the last annual report of the company.

Chicago Elevated Merger.—Henry A. Blair, who is at the head of the syndicate of New York financiers which is attempting to merge the elevated lines of Chicago, announced last week that the plans were practically completed and that he expected the details to be made public by March 15. It is said that the syndicate will make substantially the same cash offers for the stocks of the various companies that were made last fall, but the offer will probably embrace alternative propositions to exchange for securities of the new corporation. The present plan does not contemplate anything beyond the merging of the elevated properties, but the new company, which will be both a holding and an operating concern, will be built on such broad lines that it will be able to acquire other properties at some future date without the necessity of a reorganization.

Cleveland Railway Company Bonds.—Harris, Forbes & Company, of New York, have purchased a $5,000,000 issue of 5 per cent bonds from the Cleveland Railway Company, which controls the entire railway operations of that city. The proceeds of the bonds will be used to retire existing indebtedness. The bankers have offered the bonds to the public at par.

Dividends.

Chattanooga Railway & Light Company, quarterly, preferred, 1¼ per cent, payable April 1.

Engineering Securities Corporation, cash, 100 per cent, payable March 15.

General Motors Company, semi-annual, preferred, 3½ per cent, payable April 1.

Houghton County (Mich.) Electric Light Company, semi-annual, preferred, 3 per cent, common, 2½ per cent, both payable May 1.

Houghton County (Mich.) Traction Company, semi-annual, preferred, 3 per cent, common, 2½ per cent, payable April 1.

Interborough Rapid Transit Company, quarterly, 2¼ per cent, payable April 1.

Mexican Telephone & Telegraph Company, semi-annual, preferred, 2½ per cent, payable May 1.

National Gas, Electric Light & Power Company, Detroit, quarterly, preferred, 1½ per cent, payable April 1.

New York Edison Company, quarterly, 1½ per cent, payable March 14.

Otis Elevator Company, quarterly, preferred, 1½ per cent, common, 1 per cent, payable April 15.

Phelps, Dodge & Company, quarterly, 2½ per cent, payable March 30.

Safety Car Heating & Lighting Company, quarterly, 2 per cent, payable April 1.

St. Joseph Railway, Light, Heat & Power Company, quarterly, preferred, 1¾ per cent, payable April 1.

United Gas Improvement Company, Philadelphia, quarterly, 2 per cent, payable April 15.

Western Union Telegraph Company, quarterly, ¾ of 1 per cent, payable April 15.

Westinghouse Air Brake Company, quarterly, 2½ per cent, extra, 1½ per cent, special, 1 per cent, all payable April 10.

West Jersey & Sea Shore Railroad Company, semi-annual, 2½ per cent, payable April 1.

Reports of Earnings.

BELL TELEPHONE COMPANY OF CANADA.

Period.		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
Year,	1910	$5,510,685	$3,107,560	$1,547,125	$1,000,000	$547,125
Year,	1909	4,949,197	3,480,308	1,468,889	1,000,000	468,889

BELL TELEPHONE COMPANY OF PENNSYLVANIA.

Year,	1910	$18,349,425	$13,813,518	$4,535,907	$245,886	$4,290,021
Year,	1909	16,171,839	11,690,058	4,481,781	304,280	4,177,501

BLACKSTONE VALLEY GAS & ELECTRIC COMPANY.

Jan.,	1911	$113,030	$51,597	$61,433	$30,198	$31,235
Jan.,	1910	96,529	49,018	47,511	29,367	18,144

DETROIT EDISON COMPANY.

Year,	1910	$3,030,207	$1,720,124	$1,310,083	$601,701	$708,382
Year,	1909	2,199,143	1,274,578	924,565	511,702	412,863

EDISON ELECTRIC ILLUMINATING COMPANY, BOSTON.

Feb.,	1911	$515,933	$190,255	$325,678	.....	.....
Feb.,	1910	453,111	185,492	267,617	.....	.....

FEDERAL TELEPHONE & TELEGRAPH COMPANY.

Year,	1910	$889,061	$371,866	$517,195	$249,756	$267,439
Year,	1909	763,820	354,559	409,261	236,847	172,415

NEW YORK STATE RAILWAYS COMPANY.

Qr., Dec.	'10	$878,374	$486,223	$302,150	$145,832	$382,882
Qr., Dec.	'09	792,542	505,242	287,300	112,103	211,760

PIONEER TELEPHONE & TELEGRAPH COMPANY.

Year,	1910	$1,844,654	$1,385,515	$459,139	$38,617	$420,522
Year,	1909	1,534,180	1,147,053	387,127	112,721	274,405

SEATTLE ELECTRIC COMPANY.

Jan.,	1911	$478,729	$276,670	$202,059	$110,404	$91,655
Jan.,	1910	467,700	310,391	157,309	105,648	51,661

UNION RAILWAY GAS & ELECTRIC COMPANY.

Year,	1910	$2,981,711	$1,633,954	$1,347,757	$796,257	$551,500
Year,	1909	2,820,349	1,468,415	1,351,934	773,664	578,270

WASHINGTON (D. C.) RAILWAY & ELECTRIC COMPANY.

Year,	1910	$4,123,560	$2,151,828	$1,995,041	$1,280,398	$714,643
Year,	1909	4,080,064	2,110,579	1,980,087	1,230,292	749,795

WESTERN UNION TELEGRAPH COMPANY.

Qr. Mch. 31,	'11	.....	.....	$1,470,000	$433,062	$1,036,937
Qr. Mch. 31,	'10	.....	.....	1,794,998	433,062	1,361,936

General News

Construction News.

EUFAULA, ALA.—The City Council has adopted a resolution authorizing the construction of a municipal electric light plant, plans for which will soon be prepared.

PHOENIX, ARIZ.—Contracts have been awarded by the Secretary of the Interior for equipment for the Salt River irrigation project as follows: To the Wagner Electric Manufacturing Company, of St. Louis, Mo., for furnishing motors and transformers for operating pumps, for $7,778, and to the Westinghouse Electric & Manufacturing Company, for switchboards, for $1,411; to the Bryan Jackson Iron Works, of San Francisco, Cal., for furnishing centrifugal pumps, at $7,845.

SONORA, ARIZ.—The Sunset Development Company, which is developing the coal fields at Barrencia, is planning to install a producer gas plant with gas engines to drive electric generators at its works. Electricity generated at the plant will be transmitted to all points in this vicinity, including San Javier, Las Goteras, Las Barranca, Toledo and other towns and cities.

YUMA, ARIZ.—H. W. Blaisdell has applied to the Council for a franchise to construct and operate an electric light and power plant in Yuma. The proposition will be submitted to the people for referendum vote.

HELENA, ARK.—The property of the Helena Gas & Electric Company, of Helena, has been sold to a Philadelphia (Pa.) syndicate for $135,000, which, it is said, will immediately take charge of the system, and will also begin work at once on extensive improvements. The new owners are reported to have already secured a site for the proposed new power house, the cost of which with equipment is estimated at $350,000.

FRESNO, CAL.—Work has commenced on the construction of the interurban electric railway from Fresno to Kingsburg and Sanger. The main power station will be located just east of this city and a substation will be erected at Fowler.

FRESNO, CAL.—The headquarters of the San Joaquin Light & Power Company have been removed to Los Angeles, Cal. It is understood that the change will not affect the general officers in Fresno. A. G. Wishon, of Fresno, is general manager.

LOS ANGELES, CAL.—The Board of County Supervisors has called for plans and estimates of cost of the installation of a generating set in the new hall of records to supply light and heat for the county buildings, to cost approximately $20,000.

LOS ANGELES, CAL.—The Los Angeles-Pacific Railway Company is reported to have leased from the Southern Pacific Company that portion of its steam road which extends west from Clements Junction to the city limits of Los Angeles. The Los Angeles-Pacific Railway Company has applied to the City Council for permission to operate it by electricity.

MODESTO, CAL.—The Modesto Board of Trustees has sold a franchise for an electric railway through Modesto to the San Joaquin Valley Electric Railway Company, for which it paid the sum of $500.

OROVILLE, CAL.—Application has been made to the Board of Trustees by H. M. Bennett, representing the Butte County Independent Telephone Company, for a franchise in Oroville. The company, which is a subsidiary of the Home Telephone Company, proposes to spend about $200,000 in Butte County and also agrees to place its wires underground in this city.

OROVILLE, CAL.—A trust deed has been filed transferring 90,000 miners' inches of water on the middle fork of the Feather River to George H. Tully, H. B. Lind and M. P. Barnes, all of Sacramento, Cal. The rights were sold by M. E. and H. O. Lague, of Sparks, Nev. The rights are to be held in trust until the Central California Hydro-Electric Power Company is organized and financed to develop the water rights.

SACRAMENTO, CAL.—The Truckee River General Electric Company, which has been involved in the Lake Tahoe dispute, has decided to drop the matter and has yielded up its claims. The hearing of the President which was to have been held has been called off and the champions of California's rights to the waters of the lake have won the victory without a battle.

SACRAMENTO, CAL.—Adding two more members to the committee appointed to investigate the electric light service in Sacramento the Retail Merchants' Association has refused to accept the schedule of rates submitted by the power company, and has directed the committee to demand a maximum rate of 4 cents per kw-hour and a minimum rate of 3 cents per kw-hour.

SANTA ANA, CAL.—The Board of County Commissioners will soon ask for bids for the installation of an electric lighting system for the Tustin lighting district.

STOCKTON, CAL.—Arrangements are being made by the Western States Gas & Electric Company, which is a consolidation of the Stockton Gas & Electric Company and the American River Electric Company, taken over by the H. M. Byllesby Company, of Chicago, Ill., for extensive improvements to both the electric and gas service. Henry E. Adams is manager.

GREELEY, COL.—President Taft has signed a bill authorizing the Greeley-Arizona Irrigation Company to construct a diversion dam across the Colorado River at Parker, Ariz. The project will involve an expenditure of about $1,000,000.

WILMINGTON, DEL.—The City Council has applied to the State Legislature for authority to install an electric plant to supply electricity for municipal purposes and to issue bonds to the amount of $150,000 to pay for same. It is proposed to install electrical machinery in the present pumping station and to utilize the exhaust steam from the engines that operate the pumping machinery. The larger part of the bond issue will be utilized for erecting the distributing system.

BRUNSWICK, GA.—The Southeastern Yaryan Naval Stores Company, of Toledo, Ohio, is reported to be planning to erect a wood distillery for turpentine, etc. The work will include the construction of concrete buildings to cost about $60,000 and installation of machinery costing about $180,000. The equipment will include boilers with a rating of 2000 hp, two 500-hp Corliss engines, condensers and duplicate hogs, with shredders, to cost $20,000; yard tanks and electric generators and motors, at a cost of $10,000; piping, valves and fittings costing $30,000; pumps, machine shop, etc. James S. Brailey, Jr., is president of the company, present address, Hotel Oglethorpe, Brunswick, Ga.

CUTHBERT, GA.—It is reported that the Cotton Belt Telephone Company is contemplating issuing $50,000 in bonds, the proceeds to be used for improvements and extensions to its system.

DALTON, GA.—Contracts have been awarded by the City Council for extensions of electric light and water works plants, to cost about $49,424. The equipment includes one 150-hp boiler, a 300-hp feed-water heater, two turbine pumps with direct-connected induction motors, two compound condensing engines with condensers, two 150-kw alternating-current generators with five-panel switchboard, and thirty-five arc regulators. The contract for concrete reservoir, clear-water well filters, reinforced concrete power house, electric light and pumping station and installation of machinery was awarded to John W. Ash, of Austell, Ga., at $16,500. The H. S. Jaudon Engineering Company, of Savannah, Ga., has charge of the engineering work.

WASHINGTON, GA.—Plans are being prepared by the Washington Telephone Company for improvements to its system, involving an expenditure of about $2,500. W. A. Slaton is general manager.

SANDPOINT, IDAHO.—The Idaho Power & Concentrating Company is reported to be planning to erect a power and concentrating plant at Trestle Creek, eight miles from Sandpoint, this spring, to cost about $52,000.

WEISER, IDAHO.—Arrangements are being made by the Crane Creek Irrigation, Light & Power Company to begin active work on an irrigation project, which will irrigate more than 20,000 acres in this vicinity. The dam will be located on Crane Creek, fifteen miles from Weiser, and will store sufficient water to irrigate 100,000 acres.

CHICAGO, ILL.—The Chicago Railways Company is contemplating the construction of ten miles of new track during 1911.

FULTON, ILL.—The Fulton Electric Light & Power Company is reported to be contemplating the installation of a gas generating plant. The company recently increased its capital stock to secure funds for same.

TAMPICO, ILL.—The Dixon, Rock Falls & Southwestern Electric Railway Company is planning to build twenty miles of new track during the coming year.

TUSCOLA, ILL.—It is reported that plans are being considered to install an electric light plant in Tuscola, Ill.

COLUMBUS, IND.—The Indianapolis, Columbus & Southern Traction Company is contemplating the construction of a power dam in Driftwood River for the purpose of generating electricity to operate its cars between Indianapolis and Seymour. The company has purchased the old Tawnehill mill and mill race and with a new concrete dam it is estimated that the plant can supply sufficient power to operate the cars for at least six months in the year.

FORT WAYNE, IND.—We are informed that the General Electric Company did not arrange with the municipal electric light plant for service while making improvements to its power plant as stated in the issue of March 9, but has entered into a contract with the Fort Wayne & Northern Indiana Traction Company to supply electricity for lamps and motors for a term of years.

INDIANAPOLIS, IND.—The Commissioners of Marion County are making arrangements to abandon the plant which supplies light, heat and water to the county buildings and proposes to enter into contracts with private corporations to furnish the service. The county power plant, which was erected and equipped in 1901, will be closed down, as better

service can be obtained from private plants at a much less cost than to maintain the county plant.

INDIANAPOLIS, IND.—The last session of the State Legislature has passed the following bills: Giving lighting and heating companies the privilege of placing poles and transmission lines along the highways with the permission of the County Commissioners; providing for the referendum of franchise ordinances in cities and towns, and amending the present law giving the County Commissioners the right to relocate telegraph and telephone poles on the public highway.

KENDALLVILLE, IND.—It is estimated that it will cost the city about $25,000 to rebuild the municipal electric light plant. It is reported that the Toledo & Chicago Interurban Railway Company has offered to furnish electricity to operate the system at a less cost than the city can generate it.

LOGANSPORT, IND.—Plans have been adopted by the Wabash Power Company for the construction of a power house at Georgetown, four miles south in the Wabash River. The company proposes to generate and transmit electricity to towns and cities within a radius of twenty-five miles. Quincy A. Myers, W. Omer and others are interested in the project.

MUNCIE, IND.—The American Gas & Electric Company has put into operation its lighting system in Eaton, twelve miles distant. Electricity for operating the system is transmitted from the Muncie power house. The company is planning to eventually supply electricity to all towns and villages in Eastern Indiana.

NATIONAL MILITARY HOME, GRANT COUNTY, IND.—Sealed proposals will be received at the office of the treasurer, Marion Branch, National Home Disabled Volunteer Soldiers, National Military Home, Grant County, Ind., until March 27 for furnishing one electric motor-driven pump, having 500,000 gallons capacity in twenty-four hours, in accordance with plans and specifications, copies of which with blank proposals and other information can be obtained upon application to J. W. Sanderson, treasurer.

RICHMOND, IND.—The Elliot & Reid Company, of Richmond, Ind., is constructing a new warehouse, 175 ft. x 300 ft., which will be equipped with an electric traveling crane having a capacity to handle 200 tons of wire products in ten hours.

TERRE HAUTE, IND.—The Terre Haute Traction Company has secured a renewal of its contract for street lighting for a term of five years at the rate of $67 per lamp per year.

TERRE HAUTE, IND.—Announcement has been made by the Citizens' Mutual Heating Company that it proposes to erect a new power plant between Fifth and Sixth Streets, south of the Vandalia Road, the cost of which is estimated at about $100,000.

VINCENNES, IND.—The Vincennes & Washington Transit Company is contemplating extensions to its system during the present year calling for the construction of about twenty miles of new track.

AMES, IA.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until April 17 for the construction complete, including plumbing, gas piping, heating apparatus and electric conduits and wiring, of the United States post office at Ames, Ia., in accordance with drawings and specifications, copies of which can be obtained at the above office or from the custodian of site at Ames, Ia. James Knox Taylor is supervising architect.

CEDAR RAPIDS, IA.—The Peerless-V-Belt Company, of Chicago, Ill., is reported to have closed negotiations with the Commercial Club of Cedar Rapids, Ia., for the removal of its factory to this city. Plans are being prepared for the erection of a factory building, 100 ft. x 200 ft., two stories high, work on construction of which will begin at once. The company will purchase complete equipment for its machine shop and a 60-hp boiler for heating purposes. It is understood that a number of motors will also be purchased.

DENISON, IA.—The East Boyer Telephone Company, it is reported, will increase its capital stock from $5,000 to $10,000. The company is contemplating making extensions to its lines.

DODGE CITY, IA.—At an election held recently the citizens are reported to have voted against the proposition to issue bonds for the construction of a municipal electric light plant.

ELDORA, IA.—The City Council is reported to be considering the question of installing a municipal electric light plant in Eldora.

EMMETSBURG, IA.—Plans are being considered by the Emmetsburg Telephone Company for the installation of a new switchboard and other improvements during the summer.

FORT DODGE, IA.—The Fort Dodge, Des Moines & Suburban Railway Company is reported to be contemplating extending its railway to Gowrie to connect with the steam railroad in that place.

WEBSTER, IA.—Bids will be received by the City Clerk, Webster, Ia., until March 29 for furnishing equipment and material for improvements to the municipal electric light and water works systems, in accordance with plans and specifications on file at the office of the city clerk. Item 1—One battery of horizontal tubular boilers, with settings, fittings and steel smoke stacks. Item 2—One Corliss engine suitable for working under a steam pressure of 150 lb. gage and driving one 300-kva, 60-cycle, 120 r.p.m., engine type generator and belted type exciter. Item 3—One Corliss engine suited for working under a steam pressure of 150 lb. gage and driving one 200-kva, 60-cycle, 120 r.p.m., engine type generator and belted type exciter. Item 4—One Hoppes open feed water heater and purifier of 500 hp capacity, with pipe, pipe fittings, valves, etc. Item 5—One 300-kva, 60-cycle, 3-phase, 2300 or 2400-volt, 120 r.p.m., engine type generator and separate exciter. Item 6—One 200-kva, 60-cycle, 3-phase, 2300 or 2400-volt, engine type generator with separate exciter. Item 7—Switchboard with one exciter, two generator panels and feeder panels for one 3-phase power, and four single-phase lighting circuits. The city also has equipment of present plant to dispose of, including three return tubular boilers, with stacks and all fittings; one Norberg Corliss engine; two 60-kw, 125-volt, direct-current generators with instruments; one 100-kw, 125-250-volt, direct-current Fort Wayne three-wire generator direct connected to an Ideal engine with switchboard and instruments; one Smedley duplex pump; one Knowles single pump, line shaft, pulleys, belts, etc. There is about 250 hp in direct-current motors, from ½ to 40 hp, also a quantity of small power and fan motors and twenty direct-current arc lamps. P. M. Banks is city clerk.

LA CYGNE, KAN.—The City Council is reported to have adopted the ordinance providing for an issue of $30,000 in bonds, the proceeds to be used for the construction of an electric light plant and water-works system in La Cygne. The proposition will be submitted to the voters on April 3.

LONE OAK, R. F. D., PADUCAH, KY.—The citizens of Lone Oak have decided to erect a telephone system and will connect it with either the system of the Home Telephone Company or that of the East Tennessee Telephone Company.

MAYSVILLE, KY.—The Maysville Public Service Corporation, recently incorporated with a capital stock of $150,000, it is reported, will take over the plants and holdings of the Maysville Gas & Electric Light Company and the Maysville Street Railway & Transfer Company. It is understood that the new company proposes to establish a new street railway system, to be equipped entirely with new rolling stock, and enlarge the electric light plant and possibly erect a new gas house.

PADUCAH, KY.—Preparations are being made by the Paducah Traction Company for the construction of an extension to Mechanicsburg.

WHITESBURG, KY.—It is reported that arrangements have been completed for the construction of an electric light plant in Whitesburg. It is understood that a site for the power house and machinery for same have already been purchased. Eastern capitalists are said to be interested in the project.

YOWELL, KY.—The Wisconsin Steel Company, which is erecting large coke ovens at Yowell, Ky., is reported to be in the market for considerable equipment. It is reported that the company is now receiving bids for eight tubular boilers with a rating of 150 hp each, two 250-kw generators, one 100-kw generator, two 160-hp engines, to be used to drive coal crushers, and a 150-hp wide crank engine to operate the ventilating system.

PRESQUE ISLE, MAINE.—The Aroostook Valley Railroad Company is planning to build an extension from Washburn to New Sweden, a distance of twelve miles, during 1911.

ATHOL, MASS.—Arrangements have been made whereby the L. S. Starrett Company will supply electricity to operate the plant of the Athol Machine Company. The Starrett company has leased the transmission line of the Athol Gas & Electric Company, extending from Crescent Street to the Athol Machine Company's plant.

BROCKTON, MASS.—The City Council has appointed a committee to look into the question of establishing a municipal electric light plant in Brockton.

GEORGETOWN, MASS.—It is reported that the proposition to improve the present lighting system will be submitted to a vote.

GREENFIELD, MASS.—The Connecticut Valley Railway Company is contemplating the purchase of a 500-kw rotary converter for its power house in Greenfield, Mass., within the next few weeks.

NORTHAMPTON, MASS.—The city government, it is said, will appoint a commission to investigate the question of establishing a municipal electric light plant. The Massachusetts Lighting Company now controls the gas and electric light companies in Northampton.

SOUTH FRAMINGHAM, MASS.—The question of municipal ownership of the electric lighting and power systems is reported to be under consideration.

SPRINGFIELD, MASS.—The Street Lighting Department has decided to replace the arc lamps now in use on Main Street from Carew to Mill Street with new magnetite lamps. The new lamps will be installed by the United Electric Light Company without additional cost to the city.

ROCKLAND, MASS.—At a town meeting held recently a committee was appointed to consider the advisability of establishing a municipal electric light plant in Rockland.

ADRIAN, MICH.—The Citizens' Light & Power Company, of Adrian, Mich., is reported to be in the market for a 500-hp boiler and a new smokestack.

HARRISON, MICH.—It is reported that an election will be held in the spring to vote on the proposition to issue bonds for the construction of an electric light plant and water-works system.

KALAMAZOO, MICH.—It is reported that the city engineer has been

instructed to secure estimates of the cost of the construction of a municipal electric light plant in Kalamazoo.

BACKUS, MINN.—The Backus Rural Telephone Company is contemplating improvements and extensions to its system.

BLUFFTON, MINN.—The Leaf River Rural Telephone Company is reported to be planning to erect a telephone line north of Bluffton.

DULUTH, MINN.—It is reported that plans are being prepared by the Zenith Telephone Company for the erection of a telephone exchange in West Duluth capable of handling 10,000 telephones. The cost of the building and equipment is estimated at from $25,000 to $30,000.

EVELETH, MINN.—Plans are being considered for the installation of an ornamental lighting system during the coming summer to cost about $4,500.

FERGUS FALLS, MINN.—It is reported that three plans have been prepared by L. P. Wolff, of St. Paul, Minn., engineer, for the reconstruction of the city dam, recently washed out by the floods, the cost of one of which is estimated at $91,000, and that of the other two at $72,000.

ST. LOUIS PARK, MINN.—The Village Council has granted the Minneapolis General Electric Company a twenty-five-year franchise to supply electricity in this village. The Council has contracted with the company for street lighting for a term of five years, under which the company is to supply seventy-five incandescent street lamps at an annual cost of $1,500. It is expected to have the system completed within two months.

ST. PAUL, MINN.—The St. Paul Promotion Company is reported to have completed surveys and secured most of the right-of-way for the construction of an electric railway, which will extend from St. Paul to Military Camp Grounds, passing through Oakland, Highwood, Red Rock, Newport, St. Paul Park and Langdon, where it will cross the Mississippi River to Hastings, continuing to Etter, Eggleston, Redwing, Wacouta, Frontenac and Lake City, a distance of fifty-seven miles. Philip W. Herzog is president, and W. L. Sonntag, general manager, Metropolitan Opera House Building, St. Paul, Minn.

BYHALIA, MISS.—It is reported that the City Council is contemplating the installation of electric light and water plants, for which bonds to the amount of $10,000 will be issued. C. M. Henry is Mayor.

GULFPORT, MISS.—Contracts will be placed by the Gulfport & Mississippi Coast Traction Company during the next two weeks for the erection of a high-tension, three-phase, 13,200-volt transmission line, fifteen miles in length. W. F. Gorenflo, of Gulfport, Miss., is general manager.

JOPLIN, MO.—The Clifford Mining Company is reported to have awarded the contract for the construction of a 200-ton reduction mill to be erected on Shaft No. 2 of the Clifford property. The mill will be equipped for electric drive and an electric hoist installed. The Clifford Mill, No. 1, will be rebuilt and equipped for electric motor drive. B. L. Van Hoose is manager.

ST. LOUIS, MO.—Arrangements are being made by the St. Louis, Lakewood & Grant Park Railway Company for the construction of a two-mile extension in St. Louis, work on which will begin at once.

EUREKA, MONT.—Steps have been taken to organize a company to erect a telephone system for this valley. F. P. Garey, county commissioner, and J. W. McCalder are interested in the project.

LAVINA, MONT.—B. F. Fullmer, of Lewiston, Mont., is reported to be interested in a project to install an electric light plant in Lavina.

MALTA, MONT.—Application has been made to the Council by H. E. Wharton for a franchise to install an electric light plant in Malta.

LIBERTY, NEB.—The City Council is reported to be considering the question of installing an electric light system in Liberty.

TRENTON, N. J.—The Public Utility Commissioners have approved the lease whereby the Trenton & Mercer County Traction Corporation is to take over the system of the Trenton Street Railway Company. Under the terms of the lease the Trenton & Mercer County Traction Company must make certain improvements to the railway system.

RUTHERFORD, N. C.—At an election held recently the citizens voted to issue $55,000 in bonds, the proceeds to be used for the construction of an electric light plant and water-works system.

DEVILS LAKE, N. D.—It is reported that investigations are being made by parties representing Eastern interests, with a view of installing a new plant to cost about $54,000. The present plant is not able to meet the demands made upon it.

HANKINSON, N. D.—It is reported that H. G. Squires, of Galesburg, Ill., has applied to the City Council for a franchise to construct and operate an electric light plant in Hankinson.

MOTT, N. D.—The Village Council has granted a twenty-year franchise to J. Blaine to operate an electric light plant within the city limits. It is understood that the present plant, operated by Lee & Thorpe, will be enlarged and improved in the near future.

AMITYVILLE, N. Y.—The Long Island Lighting Company, recently incorporated, has applied to the Public Service Commission for its approval of the purchase of the entire property and franchises of the Amityville Electric Light Company, of Amityville; the Sayville Electric Company, of Sayville; the Northport Electric Light Company, of Northport, and the Islip Electric Light Company, of Islip, to be taken over and merged into the Long Island Lighting Company; the company also asks for permission to execute a mortgage covering properties of the constituent companies and to issue stocks and bonds thereunder. The aggregate price paid for the property is $308,672. It is proposed to issue capital stock amounting to $300,000 at par and bonds to the amount of $370,000 at not less than 85, the proceeds to be used for the purchase of the properties and for new construction, additions and improvements, amounting to about $300,000.

BROOKLYN, N. Y.—The Board of Estimate is considering the proposition of allowing the Brooklyn, Queens County & Suburban Railroad Company, a subsidiary of the Brooklyn Rapid Transit Company, to build an extension of its railway to Forest Hills, in Queens County. The company agrees to build the extension if the city will allow it to do so without paying for the franchise.

GLOVERSVILLE, N. Y.—Plans are being made by the Fonda, Johnstown & Gloversville Railroad Company, electric division, for the construction of about four miles of track in Amsterdam during 1911.

HEMPSTEAD, N. Y.—The New York & Long Island Traction Company, of Hempstead, N. Y., is in the market for one 750-kw rotary converter and three transformers.

LIBERTY, N. Y.—Contracts will be placed during the next few months by the Liberty & Jeffersonville Electric Railway Company for the construction of twelve miles of track. William Craig, of Orange, N. J., is president.

UTICA, N. Y.—It is reported that the Friendship Telephone Company, acting for the New York Telephone Company, has made an offer to purchase the outstanding stock and bonds of the system of independent telephone lines operating from Rochester, Syracuse, Utica, Canandaigua, Brockport, Weedsport, Baldwinsville, Rome, Clinton, Herkimer, Mohawk, Frankfort and surrounding territory. The deal involves over $5,000,000 in securities and payments of $2,500,000 in cash payments to security holders. It is said that the board of directors of each company has indorsed the proposition.

BARBERTON, OHIO.—A petition is reported to have been submitted to the City Council asking that electrical equipment be installed at the pumping station to supply electricity for municipal lighting.

BROOKVILLE, OHIO.—Proposals will be received by the village of Brookville, Ohio, for furnishing electricity in Brookville for street and commercial lighting and for power purposes. For further information address H. E. Wheaton, corporation clerk.

BURGOON, OHIO.—The Village Council is reported to have granted the Fostoria & Fremont Railway Company a franchise to construct and operate an electric railway in Burgoon. J. W. S. Reigle, of Findlay, Ohio, is chief engineer.

CINCINNATI, OHIO.—The Ohio Traction Company is reported to be preparing plans for the construction of a new power house at Pendleton.

CINCINNATI, OHIO.—Plans have been prepared for the erection of a sterilization plant and turbine station at the California water works, to cost not more than $25,000. Estimates submitted by Superintendent Laidlaw are as follows: For sterilization plant, $6,000; two wash water pumps, $6,000; two water turbines, with electric generators, $5,500. Estimates were also submitted for a turbine generator at the Western Hills pumping station, to cost $1,000.

GREENFIELD, OHIO.—The Board of Public Works is reported to have advertised for bids for the reconstruction of the municipal electric light system, to cost about $20,000.

GREENVILLE, OHIO.—The Greenville Electric Light & Power Company is reported to be preparing plans for extensions to its plant. The company recently increased its capital stock from $30,000 to $50,000.

NELSONVILLE, OHIO.—The Hocking-Sunday Creek Traction Company, of Nelsonville, Ohio, has purchased material to equip its railroad for electrical operation. Electricity for operating the railway will be supplied by the Nelsonville Electric Light Company. New equipment is being installed in the power plant of the Nelsonville Electric Light Company to provide for the additional service.

SPRINGFIELD, OHIO.—The City Council is considering the question of installing a municipal electric light plant.

DURANT, OKLA.—The contract for construction of the proposed municipal electric light plant has been awarded to Smith & Whitney, of Dallas, Tex., for $17,155. W. S. Shannon is city clerk.

HEAVENER, OKLA.—The Board of Trustees have granted an electric light franchise to Messrs. Moore, Cooper and Hudson, of Wilburton, Okla., which will be submitted to a vote of the people. The company agrees to furnish electricity for lamps and fans for the city hall free of charge, and to build its plant within the city limits.

WAUKOMIS, OKLA.—It is reported that work will soon begin on the construction of the proposed municipal electric light plant, for which bonds were recently voted.

BROWNSVILLE, ORE.—The Oregon Power Company has secured an option on the property of the Brownsville Electric Light Company. If the plant is taken over by the Oregon company a transmission line will be erected to Halsey, where it will connect with the line now being erected from the power plant on the McKenzie River to Albany, to supply electricity for lamps and motors in this city.

FOREST GROVE, ORE.—The City Council has granted the Independent Electric Company a twenty-five year franchise to erect and main-

tain transmission lines for the distribution of electricity over certain streets in Forest Grove.

GASTON, ORE.—The Lovegren Lumber Company is reported to be working on an extensive development near Gaston, Ore., which includes the construction of a railroad five miles in length, for which contracts have been awarded, a large sawmill and a hydroelectric power plant.

MEDFORD, ORE.—Steps have been taken by the City Council for the installation of cluster lamps in the business section of the city.

PORTLAND, ORE.—The contract for furnishing electricity for operating the new mill of Balfour-Guthrie Company in Portland has been awarded to the Mt. Hood Railway & Power Company. The mill will be equipped for single motor drive throughout and will require about 500 hp.

ALLENTOWN, PA.—Plans have been filed with the Recorder giving notice that application will be made to the Governor of Pennsylvania by W. A. Lathrop, Rollin H. Wilbur and H. F. Baker, of Philadelphia, Pa., for charters for about sixty electric companies. This is the first public move in connection with the large power scheme of the Lehigh Coal & Navigation Company, which proposes to supply electricity in the eastern portion of Pennsylvania, including Philadelphia. The company is planning to erect large power houses at Lansford, where coal will be used as fuel which heretofore has been allowed to go to waste. The main transmission lines will extend to Philadelphia, with branches to all industries, towns and villages in the districts along the route of the line. It is said that the company proposes to make a specialty of supplying electricity to cement plants in the Lehigh region.

CORAOPOLIS, PA.—Contracts have been awarded by the Town Council for equipment for the municipal electric light plant as follows: To the Buckeye Engine Company, for one 225-hp engine, and the Struthers Wells Company for two engines, one of 150-hp and the other 175 hp; for three generators to the Crocker-Wheeler Company and for switchboard to the Westinghouse Electric & Manufacturing Company.

KANE, PA.—The American Plate Glass Company, of Kane, Pa., has purchased a Westinghouse 700-hp horizontal gas engine for its power plant at James City. The engine will operate on natural gas. The engine will be connected to a Westinghouse 625-kva, 600-volt, three-phase, 25-cycle alternating-current generator, and will supply electricity for lamps and motors. The new equipment will operate in parallel with three 16 x 26 twin tandem and two 23½ x 33 single crank horizontal Westinghouse gas engines, which drive three 400-kw and two 500-kw Westinghouse generators respectively.

LANCASTER, PA.—A company has been organized by a number of influential residents of the northern part of the county under the name of the Ephrata & Denver Telephone & Telegraph Company to construct and operate a telephone line from Brickerville to Churchtown and to the Berks and Lebanon County lines. W. S. Brossman is president and H. F. Jacoby, treasurer.

MT. GRETNA, PA.—The Mt. Gretna Light & Power Company has filed an amendment to its charter increasing its capital stock from $5,000 to $25,000.

ROYERSFORD, PA.—The Council is considering the question of establishing a municipal electric light plant in Royersford.

SCRANTON, PA.—Announcement has been made by the Scranton Electric Company of extensive improvements to be made to its plant and system, which will involve an expenditure of about $1,000,000. At present the company is operating several power plants in this city and proposes to centralize its generating system in the suburban plant in Green Ridge and at the plant on the banks of the Lackawanna River. The improvements include the installation of large engines, complete condenser system, system of trackage for hauling coal to the plant and purchase of several coaling dumps. It is said a new electric plant will be erected at Carbondale.

LONSDALE, R. I.—The Lonsdale Company is reported to be contemplating installing new equipment in its power house.

PROVIDENCE, R. I.—At a special meeting of the stockholders of the Narragansett Electric Lighting Company, held March 1, the directors were authorized to issue $1,500,000 in convertible debentures, increasing the capital stock from $4,500,000 to $6,000,000. Of the proceeds $750,000 will be used to liquidate outstanding indebtedness, and the remainder will be used for extensions and future improvements.

DILLON, S. C.—Preparations are being made by the Electric Light Commission to rebuild the electric light plant, for which bonds to the amount of $15,000 have been voted. J. C. Cottingham is a member of the commission.

HONEA PATH, S. C.—The City Council is considering the question of issuing bonds to the amount of $11,000, the proceeds to be used for the construction of an electric light system.

JOHNSTON, S. C.—An additional 125-hp Corliss engine is being installed in the local electric light plant owned by F. M. Boyd.

LEXINGTON, S. C.—The proposition to grant a franchise to the Lexington Electric Light & Power Company to supply electricity in Lexington will be submitted to a vote of the people on March 28.

HILL CITY, S. D.—The Hill City Lumber Company is reported to be erecting a building in which it will install an electric power plant.

MILLER, S. D.—The Miller Electric Company is planning to install a tungsten-lamp street-lighting system at once, a new 100-hp boiler soon, erecting additional lines in several parts of the city and establishing a day service with motor load this season. Lewis Kellough is secretary and manager.

MITCHELL, S. D.—The Dakota Central Telephone Company is reported to be contemplating the installation of an automatic telephone system.

MOBRIDGE, S. D.—The Council has granted the Mobridge Electric Light, Power & Heating Company a franchise to install an electric light plant in Mobridge.

MOBRIDGE, S. D.—The Missouri Valley Telephone Company has petitioned the Council for a franchise to install and operate a telephone system in Mobridge.

CHATTANOOGA, TENN.—The Citico Furnace Company is reported to be contemplating building a new blast furnace, to cost $400,000, the installation of hot-blast stoves and probably an electrical power plant. It is understood that plans for the proposed improvements are being prepared by David G. Baker, engineer, of Philadelphia, Pa.

GALLATIN, TENN.—The Portland Mutual Telephone Company, recently organized, will take over and operate the system of the Sumner County Telephone Company. The new company has purchased the entire northern section of the system, extending to Rock Bridge. S. H. Roark is president and C. W. Kerley, secretary and treasurer.

NASHVILLE, TENN.—The installation of a new steam turbine and other improvements to its system is reported to be under consideration by the Nashville Railway & Light Company.

SHELBYVILLE, TENN.—Plans are being made by J. F. Boyd, owner of the local electric light plant, to install a new 500-kw steam turbine between now and next July.

ALVIN, TEX.—Plans are being made by H. P. Rhodes, of Houston, Tex., and associates, for the installation of an electric light plant, water works system, ice plant and bottling works in Alvin.

AUSTIN, TEX.—It is reported that C. J. Hardy, engineer, representing the firm of Ford, Bacon & Davis, of New York, N. Y., and New Orleans, La., has been making investigations in Austin with the view of submitting a proposition to the city for the reconstruction of the large dam across the Colorado River and the installation of a hydroelectric power plant in connection with the proposed water storage reservoir.

BAIRD, TEX.—It is reported that T. A. Ward, of Comanche, Tex., is contemplating the installation of an electric light system in Baird.

BEAUMONT, TEX.—The Beaumont Traction Company expects to purchase one 250-hp boiler for its power house in Beaumont in the near future. C. H. Kretz is general manager.

BROWNSVILLE, TEX.—The new machinery for the new municipal electric light and water-works plans has arrived and will soon be installed. The equipment consists of pumps having a capacity of 1,000,000 gal. per day, two Corliss engines, one of 250 hp direct connected to a 175-kva, alternating-current generator and the other a 160 hp connected to a 125-kva generator, one 210-hp water-tube boiler and two tubular boilers of 100 hp each. The cost of the improvements is estimated at about $40,000.

CANYON, TEX.—The Canyon Power Company, recently incorporated with a capital stock of $25,000, is reported to have purchased the property of the Canyon Ice & Light Company, and proposes to install additional ice machinery, to cost $7,500. C. R. McAfee is president and manager.

CRYSTAL CITY, TEX.—Arrangements are being made by E. C. Robinson, of St. Louis, Mo., for the installation of an electric light and ice plant in Crystal City, Tex.

DENTON, TEX.—Plans are being made by the Denton Traction Company for the construction of about two miles of new tracks, contract for which will be awarded in the near future.

GALVESTON, TEX.—The State Legislature has passed a bill granting the County of Galveston the right to sell or lease a right of way for an electric or steam railway over or upon the sea wall that has been constructed along the Gulf. The sea wall is about five miles long.

HOUSTON, TEX.—Preparations are being made by the Bay Shore Traction Company, of Houston, Tex., for the construction of its proposed interurban electric railway, which is to extend from South Houston to La Porte, work on which is to begin within ninety days.

HOUSTON, TEX.—Proposals will be received unil March 21 by Edgar Odell Lovett, president, 1110 Scanlan Building, Houston, Tex., for electric wiring and electrical installation. Plans and specifications can be obtained at the office of Cram, Goodhue & Ferguson, architects, Scanlan Building, Houston, Tex.

MISSION, TEX.—The Mission Cotton Oil Company, recently organized by Brownsville and Mission business men and the Hubbel-Slack Company, of Houston, Tex., proposes to build a plant in Mission to manufacture cottonseed oil and install an electric plant to generate and supply electricity in Mission and also supply water for municipal purposes. It is expected to have the plant ready for operation by the middle of next August.

RAYMONDVILLE, TEX.—It is reported that S. L. Gill and James Lagro, of Raymondville, are contemplating the installation of an electric light plant and water-works system in this town.

SAN ANTONIO, TEX.—The Terrell Well Company, recently chartered with a capital stock of $100,000, is reported to be contemplating the construction of an electric railway system between San José and San Antonio, a distance of five miles. C. D. Garrett, of St. Louis, Mo., is president; A. L. Matlock, of San Antonio, Tex., secretary, and Dr. Frederick Terrell, of San Antonio, Tex., treasurer.

ST. AUGUSTINE, TEX.—Bids will be received until March 21 by the Mayor and City Council of St. Augustine for construction of waterworks system, including electric motor or gasoline engine, triplex pumps, steam pumps, boilers, etc. The O'Neil Engineering Company, 1503 Praetorian Building, Dallas, Tex., has charge of the engineering work.

TEXARKANA, TEX.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until April 3 for an electric passenger elevator in the United States court house, Texarkana, Tex., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

TRINITY, TEX.—The Trinity Light Company is contemplating overhauling its plant and installing a 50-hp gasoline, oil or gas producer engine. A. R. MacDonald is owner.

TYLER, TEX.—The Tyler Electric Company is planning to increase its motive power and change the system to polyphase, alternaitng-current. A. E. Judge is president and manager.

SALT LAKE CITY, UTAH.—Preparations are being made by the Utah Light & Railway Company for the construction of an extension from Salt Lake City to Holliday, calling for about five miles of single track.

SALT LAKE CITY, UTAH.—Preparations are being made by the Payson Electric Railroad Company to build an electric railway between Salt Lake City and Payson. Application will soon be made for franchises from the City Council of Salt Lake City and from the County Commissioners.

GRAHAM, VA.—The Graham Electric Railway Company is reported to be contemplating the construction of a power plant. It is understood that the development of a water-power near Burkes Garden is under consideration.

RICHMOND, VA.—The Council Committee on Electricity has revoked the contract of the city with Storms & Company, of Newark, N. J. for the construction of the overhead system for the municipal electric light plant in Richmond. The contract called for an expenditure of about $65,000. The committee has authorized E. W. Trafford, engineer, to secure prices on wire, mast arms and other supplies and submit a report of the cost of completing the work as soon as possible. It is estimated that the company has completed about one-third of the contract.

ELLENSBURG, WASH.—The City of Ellensburg is reported to be considering extensive improvements to the municipal electric light plant, which will involve an expenditure of about $30,000.

ELMA, WASH.—The City Council is reported to be contemplating the construction of a municipal hydroelectric plant, to cost about $12,000.

HUSUM, WASH.—Plans are being prepared by the Husum Power Company for the erection of a large dam across the White Salmon River, near the present intake of the power plant. It is estimated that the new dam will develop about 1000 hp, and it is expected that the present power plant will be enlarged.

SEATTLE, WASH.—The Board of Public Works has rejected all bids for the installation of cluster lamps on subdivision No. 1 on Third Avenue, in this city.

SPOKANE, WASH.—The Spokane & Inland Empire Railroad Company is planning to build sixty-five miles of new track during 1911.

WASHOUGAL, WASH.—The City Council has granted a franchise to the Mount Hood Railway, Light & Power Company to supply electricity for lamps and motors in Washougal.

ALBANY, WIS.—It is reported that the local electric light plant was recently destroyed by fire.

BELOIT, WIS.—The Home Telephone Company has awarded the contract for its new central station to Cunningham Brothers, of Beloit, Wis.

EAU CLAIRE, WIS.—The Chippewa Valley Railway, Light & Power Company is contemplating the purchase of one 300-kw motor-generator set for its power plant at Eau Claire. George B. Wheeler, of Eau Claire, Wis., is general manager.

LOMIRA, WIS.—The Lomira Electric Light & Power Company, recently incorporated with a capital stock of $12,000, has been granted a franchise to construct and operate an electric light plant in Lomira. P. J. Zeidler is president.

OCONOMOWOC, WIS.—The City Council has accepted the proposition, recently submitted by Henry Schoelkopf, of Milwaukee, Wis., to sell to the city the entire output generated at his new hydroelectric power plant to be erected at Okauchee Lake.

PLYMOUTH, WIS.—The Spring Telephone Company, recently organized, is planning to erect a rural telephone line southwest from the city limits, five miles in length.

RACINE, WIS.—It is reported that the local electric power plant of the Milwaukee Electric Railway & Light Company was recently destroyed by fire, causing a loss of about $125,000. It is expected that power for operating the system for the present will be secured from the Milwaukee plant.

RICHLAND CENTRE, WIS.—Plans are being made for the erection of a brick or reinforced concrete chimney, 125 ft. high and 3 ft. 6 in. in diameter, if round, and 3 ft. 4 in. if square, at the municipal electric light and water plant. W. G. Kirchoffer, of Madison, Wis., is engineer.

ROCK FALLS, WIS.—Steps have been taken toward the organization of a telephone company. It is proposed to erect an exchange in Rock Falls and connect with the telephone system in Eau Claire, Wis.

SABIN, WIS.—The Mill Creek Telephone Company has filed amendments to its charter increasing its capital stock from $3,000 to $15,000.

SUN PRAIRIE, WIS.—At a special election held recently the citizens voted to issue $9,000 in bonds, the proceeds to be used for the installation of an electric light system in Sun Prairie.

ST. VITAL, MAN., CAN.—The municipality of St. Vital is reported to have decided to install an electric street railway system, work on which will begin this spring.

TORONTO, ONT., CAN.—The Canadian Pacific Railroad Company is reported to be contemplating making arrangements for large extensions to its telephone service.

TORONTO, ONT., CAN.—Plans are being made to extend the telephone dispatching system on the Grand Trunk Railway, which will call for the erection of between 250 and 300 miles of wire between Toronto and Sarnia.

UNDERWOOD, ONT., CAN.—Sealed bids will be received by D. Mc Naughton, president of the Bruce Municipal Telephone System, Underwood, Ont., Can., until March 18 for the construction of a telephone system in the townships of Bruce, Saugeen, Greenock, Kincardine and Elderslie. Plans and specifications may be seen and forms of tender obtained at the office of W. L. Bland, Kincardine, Ont., and at the office of George J. Beattie, 72 Victoria Street, Toronto, Ont., Can.

MONTREAL, QUE., CAN.—It is reported that a syndicate is being formed to build an elevated railway fourteen miles in length, extending along Craig Street to St. James from the western to the extreme eastern limits of Montreal.

MONTREAL, QUE., CAN.—The Quebec Legislature has granted an extension of forty-two years to the franchise of the Montreal Street Railway and has passed a bill authorizing the company to amalgamate all lines under its jurisdiction under the name of the Montreal Tramways Company, with a capital stock of $2,000,000.

SHERBROOKE, QUE., CAN.—Contracts for machinery for the new municipal electric light plant have been awarded as follows: For electrical equipment, to the Canadian Westinghouse Company, of Hamilton, Ont., Can., for $33,007, and for hydraulic machinery, to the Jenckes Machine Company, of Sherbrooke, Que., for $14,000.

REGINA, SASK., CAN.—Arrangements are being made for the construction of the municipal street railway system in Reginia, work on which will begin as soon as the weather will permit. The proposed railway will be six miles in length. The power plant and car shops will be located in Regina. Six cars will be operated and electricity will be supplied for lamps. L. A. Thornton is city engineer.

SASKATOON, SASK., CAN.—Proposals will be received by the city clerk until April 3 for a street railway franchise. For further information address James Clinkskill, Mayor.

SASKATOON, SASK., CAN.—Bids will be received until March 27 by James Clinskill, Mayor, as follows: (a) For one 750-kw, 2200-volt, 60-cycle, 150 r.p.m., two-phase generator exciter, switchboard, installed complete (alternate bids on the above are asked in three-phase); (b) one 1250-hp, 120 r.p.m. vertical cross-compound Corliss engine with necessary condensing apparatus and feed-water heaters installed complete; (c) direct-connected exciter engine to drive the exciter for a 750-kw generator; (d) one steel smokestack, 100 ft. high, and inside diameter of 80 in., together with corresponding connection to boilers, installed complete. Specifications will be furnished on application to Mayor or City Commissioners.

MATAMOROS, TAMAULIPAS, MEX.—The Sautema Agriculture Syndicate, which is constructing a large irrigation system in the State of Tamaulipas, near Matamoros, has completed the first series of dams for creating water storage reservoirs. The main canal of the proposed system will be ninety-six miles long, and it will have several hundred miles of laterals, and when completed will irrigate about 600,000 acres of land. Large pumping plants will be installed. The main water supply will be obtained from the San Juan River. Antonio G. Canalizo, of the City of Mexico, is at the head of the enterprise.

MEXICO CITY, MEX.—Surveys are being made by the Mexico Traction Company, of the City of Mexico, for its proposed interurban electric railway to extend from this city to Puebla, a distance of 160 miles. It is understood that work on construction of the road will soon begin. The company, it is said, also contemplates the construction of an electric railway from this city to Cuernavaca, about seventy-five miles in length.

MEXICO CITY, MEX.—The federal government has entered into a contract with the Ericsson Telephone Company, of Mexico City, for the construction of a long-distance telephone line between this city and Puebla, a distance of 160 miles, connecting with the local system of the Ericsson company in this city, and with the telephone system of Juan Lavin in Puebla. Under the terms of the contract the government is to supply the wire and other construction material, and the proceeds from the operation of the line shall be divided between the government, the Ericsson Telephone Company and Mr. Lavin. Work will soon begin

on the construction of the line. The Ericsson Telephone Company is contemplating the construction of other long-distance lines in the States of Puebla and Vera Cruz.

SALTILLO, MEX.—Herculnao Cerda and Vicente Garcia Fuentes, of Saltillo, are reported to be interested in a project to install a hydro-electric plant near this city, to supply electricity for lamps and motors for towns and industries in this region.

New Industrial Companies.

THE AUTOMATIC ELECTRIC RAILWAY BLOCK SIGNAL COMPANY, of Birmingham, Ala., has been chartered for the purpose of manufacturing a device to be used by steam, electric and motor railroads for prevention of collisions. The officers are: A. C. Foster, president; M. R. Julian, vice-president; L. J. Haley, secretary and attorney, and E. F. Enslen, treasurer.

THE CENTRAL ELECTRIC SUPPLY COMPANY, of South Bend, Ind., has been chartered with a capital stock of $10,000 by John W. Arnold, E. F. Hart, of South Bend, Ind., and Earl H. Arnold, of Gary, Ind. The company proposes to manufacture and sell at wholesale and retail all electric supplies and metal articles; also to furnish and install and use any kind of motive power pertaining to electrical business, and to take contracts for all kinds of electric wiring, electric appliances, fixtures, etc.

THE CODY MOTORS COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 by Arthur McMullen, Jr., 143d Street and Riverside Drive; Reginald L. Kelly, 239 West 109th Street, and John C. Mullin, Hotel Woodward, all of New York, N. Y. The company proposes to manufacture automobiles, electric motors, etc.

THE EVANSVILLE MARINE MOTOR & FOUNDRY COMPANY, of Evansville, Ind., has been incorporated by B. F. Duery, C. F. Donnelly, C. I. Bloomer and B. M. Mitchell. The company proposes to manufacture engines, boilers, machinery, parts and patterns and to do a general electric motor and repair business.

THE FIDELITY INVESTMENT COMPANY, of Nashville, Tenn., has been incorporated with a capital stock of $200,000. The company proposes to construct electric railroads, electric power houses, etc. H. H. Mayberry, of Nashville, Tenn., is interested in the enterprise.

THE GAS & ELECTRIC IMPROVEMENT COMPANY, of Boston, Mass., has been incorporated with a capital stock of $100,000 by C. Frank Whittmore, George F. Howland, Cyrus N. Burnill and Jeremiah J. Hourin.

THE HANDLESS TELEPHONE RECEIVER COMPANY, of Camden, N. J., has been incorporated with a capital stock of $125,000 to acquire letters patent granted on a handless telephone receiver attachment and to do a general electrical business. The incorporators are: J. B. Fellheimer, J. G. Donohue and D. C. Reed, of Camden, N. J.

THE HYDRAULIC DRIVE COMPANY, of Indianapolis, Ind., has been incorporated by Fred H. Cheyne, Charles S. Walker and Thomas H. Endicott. The company is capitalized at $50,000 and proposes to manufacture machinery and devices for the transmission and regulation of all kinds of power.

THE IDEAL ELECTRIC VEHICLE COMPANY has been chartered under the laws of New Jersey with a capital stock of $250,000. Herman A. Tufel, of Maplewood, N. J., is one of the incorporators.

THE MACBETH ARC LAMP COMPANY, of Philadelphia, Pa., has been incorporated with a capital stock of $12,000. The directors are: Norman Macbeth, 3104 Midvale Avenue, Philadelphia, Pa., treasurer; James H. Hill, of Philadelphia, Pa., and James Coutts, of Glen Olden, Pa.

THE MORTON MOTOR COMPANY, of Detroit, Mich., has been organized for the purpose of manufacturing motor engines. Charles N. McNaughton is president.

THE MOTOR & MANUFACTURING COMPANY, of Indianapolis, Ind., has filed articles of incorporation with a capital stock of $300,000 by W. S. McDonald, J. O. Vanier and G. R. Brown. The company proposes to manufacture gasoline engines and motors of all kinds and parts of all kinds of self-propelling vehicles, all kinds of machinery and devices.

THE NATIONAL GOVERNOR COMPANY, of New York, N. Y., has been incorporated with a capital stock of $2,000,000. The company proposes to introduce economies in the manufacture and consumption of gas and electricity for light, heat and power purposes. The directors are: Frederick G. C. Lyon, Henry S. Reynolds and Graham Smith, of New York, N. Y.

THE ROTH-MURPHY ENGINE STARTER COMPANY, of Indianapolis, Ind., has been chartered with a capital stock of $50,000 for the purpose of manufacturing a patented device known as the Roth-Murphy starter. The incorporators are: David R. Murray, of Indianapolis, Ind.; Gilson W. Roth, of Morgantown, Ind., and others.

THE RUSH MARINE SIGNAL COMPANY, of New York, N. Y., has been incorporated with a capital stock of $500,000 to manufacture and deal in engines, machinery, etc. The incorporators are: W. S. Rush, Captain J. W. Edwards and C. Wagner, of New York, N. Y.

THE SOUTHERN EQUIPMENT & SUPPLY COMPANY, of Bedford, Ind., has been chartered for the purpose of manufacturing all kinds of equipment and supplies for electric power, heating, gas and water plants, quarries and other concerns using machinery. The directors are: Horace C. Stilwell, C. F. Fletcher and others.

THE STEEL CONDUIT COMPANY, of Penn Yan, N. Y., has been chartered with a capital stock of $75,000 by W. T. Morriss, H. M. Short and E. R. Ramsey, of Penn Yan, N. Y. The company proposes to manufacture electrical conduits and insulating devices.

THE TELLER AIR-BURNING FURNACE COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $300,000 by F. A. Wineke, J. Morfit Mullen and W. A. Duvall, all of Baltimore, Md. The company proposes to manufacture furnaces, boilers, engines, machinery, etc.

THE UVALDE CONTRACTING COMPANY, of New York, N. Y., has been incorporated by J. D. Marston, of Yonkers, N. Y.; F. S. Brown, of Brooklyn, N. Y., and J. J. Ahearn, of Bronx. The company is capitalized at $100,000 and proposes to do a general contracting and engineering business.

THE VACUUM CLEANER MANUFACTURING COMPANY, of Camden, N. J., has been incorporated with a capital stock of $100,000 to manufacture vacuum dry-cleaning machines. The incorporators are: F. A. Kuntz, J. P. Murray and N. G. Wiltshire, of Camden, N. J.

THE WESTERFIELD GAS & ENGINE COMPANY, of Indianapolis, Ind., has been incorporated by G. G. Westerfield and A. H. Nordyke. The company is capitalized at $50,000 and proposes to do a general gas engine and traction manufacturing business, including the manufacture of accessories pertaining thereto.

THE WILSON ELECTRIC COMPANY, of Canton, Ohio, has been incorporated with a capital stock of $10,000 by J. B. Wilson, Ellen C. Wilson and others to take over a partnership which has been known as the Wilson Electric Company.

New Incorporations.

GREENVIEW, ILL.—The Greenview Electric Light & Power Company has been incorporated with a capital stock of $10,000 by James — Bracken, Alvin H. Cleveland and John Larson.

LEXINGTON, ILL.—The Lexington Telephone Company has been incorporated with a capital stock of $6,000 by J. L. Vawter, G. K. Elder an J. J. Withers.

PEORIA, ILL.—The St. Louis, Peoria & Northwestern Railway Company has been incorporated with a capital stock of $25,000 to build an electric railway from a point in or near Peoria through the counties of Peoria, Tazewell, Mason, Menard, Sangamon and Macoupin to a connection with the Macoupin County Railway at a point about two and one-half miles south of Girard. The directors are: Marvin Hughitt, Chauncey Keep, Byron L. Smith and B. Conway, of Chicago, Ill.; John V. Farwell, of Lake Forest; William A. Gardner, of Evanston, and John D. Caldwell, of Oak Park, Ill.

VIRDEN, ILL.—Articles of incorporation have been filed for the Virden Telephone Company with a capital stock of $25,000 by U. G. Tucker, N. Shell and Charles H. Snell.

BYRON, IND.—The Byron Telephone Company has been incorporated with a capital stock of $10,000 by H. I. Demeree, C. A. Morgan and T. M. Garland.

WASHINGTON, IND.—The Citizens Light & Fuel Company has filed articles of incorporation with a capital stock of $75,000 for the purpose of constructing and operating electric and gas plant and supplying electricity and gas for lamps, heat and power purposes. The incorporators are Paul M. Taylor, Thomas Burns and L. P. Boyle.

COIN, IA.—The Buck Creek Mutual Telephone Company has been incorporated with a capital stock of $5,000 by M. H. Meyers, Frank Annan, H. D. Ellis, W. L. Annan, Herman Seifering, Henry Muler and J. H. Myers.

SOMERSET, KY.—The United Water, Light & Traction Company has filed articles of incorporation with a capital stock of $100,000 by William Waddle, C. F. Smith, A. A. Tuttle, M. O. Curd and B. L. Waddle, all of Louisville, Ky.

AUGUSTA, MAINE.—Articles of incorporation have been filed for the Dirigo Power Company with a capital stock of $500,000. The company proposes to generate electricity. S. S. Lancaster is president and H. M. Shaw, treasurer, both of Augusta, Maine.

RUMFORD, MAINE.—The Andover Power Company has been incorporated with a capital stock of $50,000 for the purposes of developing water powers in the town of Andover and supplying power for manufacturing purposes. The directors are: Richmond L. Melcher, James McGregor and Waldo Pettingill, all of Rumford. Mr. McGregor is president of the company.

WINTHROP, MAINE.—The Alamo Power Company has been organized with a capital stock of $50,000 for the purpose of developing and distributing power. E. M. Leavitt, of Winthrop, Maine, is president and treasurer.

BOSTON, MASS.—The Jacksonville Traction Company has filed articles of incorporation with the Secretary of State with a capital stock of $1,500,000.

LAUREL, MISS.—The Laurel Light, Heat & Power Company has been incorporated with a capital stock of $30,000 by J. T. Pullen, of Laurel, Miss., and F. F. Young, of Jackson, Miss.

CLEVELAND, OHIO.—The Star Electric Company has been incorpo-

rated with a capital stock of $10,000 by D. H. Tilden, A. A. McCaslin, M. Ferrell, J. M. Brug and Elmer G. Derr.

CLEVELAND, OHIO.—Articles of incorporation have been filed for the Whitney Power Company with a capital stock of $50,000 by Donald McBride, T. M. Kirby, Ellis R. Diehm, C. Cowne Ownes and W. B. Whitney.

EAST LIVERPOOL, OHIO.—Articles of incorporation have been filed for the Tri-State Railway & Electric Company with a capital stock of $10,000 by W. J. Phelp, F. J. Brady, W. R. Griffin, B. E. Pollock and W. B. Moore. The company proposes to operate an electric railway between East Liverpool and Steubenville.

HARRISBURG, PA.—Articles of incorporation have been filed with the Secretary of State for the following companies: The Hellam Township Light, Heat & Power Company, the Spring Garden Township Light, Heat & Power Company and Springetsbury Township Light, Heat & Power Company. Each company is capitalized at $5,000 and the directors are: Charles A. Greenawalt, treasurer; Harrison B. Waltman and James J. Gerry, all of York, Pa.

Personal.

MR. CHARLES MURRAY has been appointed general manager of the Northwestern Railways Company which controls the lighting and railway companies at Meadville, Pa.

MR. F. G. WATERS, who has been general manager of the Municipal Electric Light Plant, Jewett City, Conn., for the past four years has tendered his resignation to take effect on May 1.

DR. S. W. STRATTON, director of the Bureau of Standards, Washington, delivered an illustrated lecture before the Westinghouse Club, Wilkinsburg, Pa., on March 8, his subject being the work of the bureau.

MR. FRANCIS A. J. FITZGERALD, M. I. T., '95, consulting chemical engineer, Niagara Falls, will present a paper on "An Electric Furnace for Zinc Smelting" before the Congress of Technology to be held in Boston April 10-11.

MR. GEORGE A. CAMPBELL, research engineer with the American Telephone and Telegraph Company, will present before the Congress of Technology to be held in Boston April 10-11 a paper under the title "Cisoidal Oscillations."

MR. JAMES A. MATTHEWS has resigned his position as manager and superintendent of the Moore & Deller Electric Light & Power Company, Pagosa Springs, Col., and has accepted a similar position with the municipal plant at Del Norte, Col.

MR. JAMES D. MORTIMER, vice-president and secretary of the Milwaukee Electric Railway & Light Company, will temporarily assume the presidency of the company, made vacant by the resignation of John I. Beggs, who has accepted the presidency of the St. Louis Car Company.

MR. C. W. STONE, of the General Electric Company, will speak before the Electrical Engineering Society of Columbia University on Friday evening, March 17, at 8:15 o'clock, on the subject of "Electric Lighting." The lecture will be held in the Engineering building of the university and is open to the public.

MR. P. N. GOLDEN, who was employed by the Middletown (Conn.) Electric Light Company when its new plant was being installed last summer, has been appointed superintendent of the plant to relieve Mr. L. C. Whitney, who will devote his whole time to the management of the general affairs of the company.

MR. W. J. TROTT, of the Fostoria Incandescent Lamp Company, Fostoria, Ohio, addressed the Kalamazoo branch of the Michigan State Society of Stationary Engineers at a recent meeting. Mr. Trott spoke on the use of electric lamps in industrial illumination, and illustrated his talk with stereopticon views.

MR. H. M. WINTER has resigned as manager of the Seattle office of the General Electric Company to become sales manager of the Seattle Electric Company. He is succeeded by Mr. C. M. Bliven, sales agent of the General Electric Company in San Francisco, who in turn is succeeded in San Francisco by Mr. William M. Shepard.

MR. J. C. ROCKWELL has been retained by J. G. White & Company as superintendent of transportation and general superintendent of the Manila Electric Railroad & Light Company, Manila, Philippine Islands. Mr. Rockwell is a graduate of Cornell, and was formerly superintendent of the Charleston Interurban Railroad, Charleston-Kanawha, W. Va.

MR. WALTER L FISHER, who as special traction counsel to the Chicago City Council drafted the present street-railway franchises, under which full protection is given to the bondholders and which assure the City of Chicago 55 per cent of the net profits, has been appointed by President Taft Secretary of the Interior, to succeed Mr. R. A. Ballinger, who has resigned.

MR. N. M. ARGABRITE, who resigned as manager of the Public Service Operating Company, Belvidere, Ill., to become connected with the American Gas & Electric Company, has been placed in charge of the Hartford City (Ind.) Lighting Company. Mr. Argabrite was formerly connected with the Ashland Electric Light & Power Company, Ashland, Ky.; Ohio Valley Electric Company, and the Winona Railway & Light Company, Winona, Minn.

MR. W. H. BEATTYS, who for the last five years has been connected with Westinghouse interests in the Chicago office, has become Western district manager for the National Brake & Electric Company, with offices in the First National Bank Building, Chicago. The territory covered by this office extends from Detroit to the Pacific Coast. Previous to his five years with the Westinghouse interests, Mr. Beattys was connected with the company to which he has now returned.

MR. HENRY W. THORNTON has been elected president of the Northwestern Railways Company, which has recently taken over the Meadville & Connaught Lake Traction Company, Meadville Traction Company and the People's Incandescent Light Company, Meadville, Pa. Mr. Thornton is assistant general superintendent of the Long Island Railroad and will assume his new duties without relinquishing his present connections in Long Island City.

MR. A. PAWLING, president of the Pawling & Harnischfeger Company, crane manufacturer, Milwaukee, has gone with his family on an extended automobile trip through the Southern and Pacific Coast States and will return to Milwaukee next June. At a recent meeting of the board of directors of the company, Mr. S. H. Squier was elected secretary, while Mr. W. H. Hassenplug, sales manager, was made second vice-president. These gentlemen, together with Mr. F. P. Breck, were also elected to the board of directors.

MR. F. F. ESPENSCHIED, formerly general manager of the Interstate Light & Power Company at Galena, Ill., is now with the Hydro-electric Power Commission of Ontario, with headquarters in Toronto. At present Mr. Espenschied is engaged as assistant engineer, acting in a consulting capacity with several municipalities which have contracted with the commission for large blocks of Niagara energy. For four years after graduating from Cornell, in 1905, Mr. Espenschied was with the West Penn Railways Company, at Connellsville and Pittsburgh, Pa.

Trade Publication.

AUTO-TRANSFORMER.—Bulletin No. 534 of the American Transformer Company, Newark, N. J., is devoted to auto-transformers for use with low-voltage tungsten lamps. These transformers are particularly well suited for sign-lighting, as well as house-lighting installation.

BUSINESS NOTES.

ORNAMENTAL STREET-LIGHTING POSTS WITHSTAND SEVERE FIRE.—The severe fire in the business section of Minneapolis on March 5, which, for a time, threatened to destroy almost the entire retail business district of the city, tested out the ornamental street lighting posts within the territory swept by the fire. The scorching heat would have seriously damaged the ordinary post, but those placed here withstood the test without damage. These posts were supplied by the Flour City Ornamental Iron Works, which firm is naturally very proud of the manner in which they withstood this severe test.

TRIUMPH ELECTRIC COMPANY.—A delegation of about seventy-five shop superintendents and managers from Chicago attended the annual meeting of the Cincinnati Metal Trades Association on Thursday, March 2. During the course of the day the entire party inspected the plant of the Triumph Electric Company, and were very favorably impressed with the modern methods employed in the shops. The Triumph Company is exceptionally busy at the present time, and in addition to the ordinary day shift is working a night shift three nights a week. A banquet was held in the evening at the Business Men's Club, and a thoroughly enjoyable time was spent.

WESTINGHOUSE LAMPS.—The Westinghouse Lamp Company, of Bloomfield, N. J., has just added the 40 and 60-watt sizes of its line of wire-type tungsten lamps. These sizes will now be listed regularly in the line of continuous filament lamps that have overcome the objections made to tungsten lamps on account of their fragility. Among several large lamp contracts recently made, one is with the Harriman interests for $140,000 worth of lamps for the various railroad and steamship lines, and another one is with the Schoepf-McGowan electric railways in Ohio and Indiana for $35,000. Other recent contracts are as follows: J. R. Lehmer, Omaha, Neb., $17,000; J. P. Coghlin, Worcester, Mass., $10,000; Elliott Lewis Electrical Company, Philadelphia, Pa., $10,000; Pennsylvania Railroad lines, east and west, Philadelphia, $70,000.

DIAMOND RUBBER COMPANY.—The Diamond Rubber Company, Akron, Ohio, has recently received visits from representatives of a number of electrical jobbing houses that handle Diamond rubber-covered wire and cable, and it is stated that almost without exception the visitors were considerably surprised and deeply impressed with the size of the Diamond factories, and particularly that portion devoted to the manufacture of wire, which occupies a large five-story building and portions of another building. The factories contain a complete and up-to-date line of rapid braiders and stranding machines and two enormous lead presses, one made by Krupp and recently imported from Germany. Arrangements for handling Diamond rubber-covered wire and cables have been made with the National Electrical Supply Company, Washington, D. C.; James Clark, Jr., Electric Company, Louisville; Stuart-Howland, Company, Boston, Mass.; Miller-Selden Electric Company, Detroit, Mich.; Post-Glover Electric Company, Cincinnati, Ohio; Erner & Hopkins Company, Columbus, Ohio, and Julius Andrae & Sons Company, Milwaukee.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FED. 28, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City]

985,775. ATTACHMENT PLUG; T. A. C. Both, New York, N. Y. App. filed Sept. 2, 1910. For lamp sockets, including a metal screw shell carrying an insulator with a spring contact in the opening in the body, a center contact connected to the spring, and a detachable cap with central stud co-operating with the spring contact.

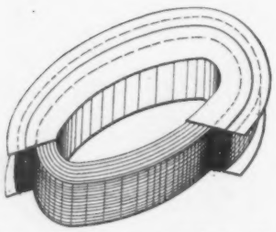
985,791. JUNCTION BOX FOR SPARKING PLUGS; J. Dubail, Delle, France. App. filed June 1, 1910. A washer with lateral opening for the introduction of a conductor carrying wires which are spread and clamped by a tightening nut, the device being secured to the sparking plug.

985,819. ELECTROMAGNETIC BRAKE; J. N. Mahoney, Wilkinsburg, Pa. App. filed July 29, 1909. For braking electric motor-driven vehicles, the motors being connected as generators to give the braking action, the main field of one motor being cross-connected with the armature of another in each group, and an equalizing connection connecting a main motor field of one group with that of another.

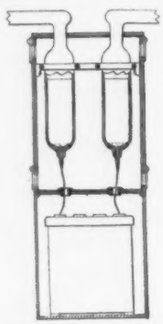
985,820. PARTY LINE RINGING KEY; R. H. Manson, Elyria, Ohio. App. filed April 17, 1909. A frame-carrying switch operating means and switch springs with their contacting ends open at the rear, the other ends being connected to the frame.

985,821. ELECTRICAL TERMINAL CONNECTOR; R. H. Manson, Elyria, Ohio. App. filed Nov. 17, 1909. A movable resilient member with terminal recess into which a terminal is inserted and a bent wire clip with registering apertures through which the terminal plug passes.

985,838. AUTOMATIC ELECTRIC WELDING MACHINE; A. F. Reitzel, Lynn, Mass. App. filed Oct. 25, 1905. The work-supporting belt carries the work beneath a reciprocating tool, and current is passed between the tool and the work, the links of the belt being cut away to afford passage for the current.



986,291.—Construction of Coils for Electrical Apparatus.



986,304.—Vacuum-Tube Lamp.

985,854. COHERER; W. E. D. Stokes, Jr., New York, N. Y., and G. W. Davis, Galilee, N. J. App. filed Oct. 9, 1908. The contact faces of two blocks of galena and arsenical copper ore for an automatic coherer.

985,932. ELECTRIC MOTOR REGULATION; A. F. Pieper, Rochester, N. Y. App. filed April 26, 1905. Alternating-current commutator motor with a small number of active turns in the armature circuit producing a much lower counter e.m.f. under speed than the impressed e.m.f., so as to avoid sparking at the commutator, the rotation of the armature controlling a governor for interrupting the motor circuit at a certain speed.

985,942. CIRCUIT-CONTROLLING APPARATUS; J. Sachs, Hartford, Conn. App. filed April 5, 1907. For controlling a switch near-by or at a distance by means of an electro-magnetic device operating a spindle with two coils, one in circuit with the source of supply, and the other in shunt to the main, with circuit closers in the circuits.

985,951. BRUSH HOLDER; L. H. Sparks, Warren, Ohio. App. filed Feb. 5, 1910. Current connections are made directly with the brushes to avoid heating the brush holders by means of a stud mounted upon insulation, to which the brush is connected.

985,981. MAGNETO DYNAMO ARMATURES; R. H. Cunningham, New York, N. Y. App. filed Dec. 30, 1909. Armatures for high-tension magneto, with two segmental portions joined by a connecting web which is divided between the segmental portions.

985,983. ELECTRIC HEATER FOR INCUBATORS, BROODERS AND THE LIKE; G. M. Curtis, Buffalo, N. Y. App. filed April 30, 1907. A flat plate with yielding means for closing a recess between the plate and an electrical heating device, which may consist of a plurality of electrical lamps on a frame, carried by the support inside of the incubator.

986,023. THERMOSTAT; H. Y. Norwood, Rochester, N. Y. App. filed Nov. 29, 1909. Prevents breaking the platinum wires of a thermostat in which the circuit is closed by mercury thermometer with platinum inleads by securing the wires to the casing by electro-deposit.

986,028. COMMUTATOR TYPE DYNAMO ELECTRIC MACHINE; W. H. Singer, West Allis, Wis. App. filed June 13, 1910. For preventing movement of conductors by centrifugal force, the winding having cross connectors and the retaining member comprising concentric rings mounted on the commutator supporting the cross connectors.

986,030. ROSETTE; J. S. Stewart, New York, N. Y. App. filed Oct. 5, 1909. A porcelain housing having grooves to receive the wires and metal clips for the terminal screws. Details.

986,033. INDUCTION COIL; R. Varley, Englewood, N. J. App. filed May 8, 1909. Loads the primary winding with a few turns directly at the pole which actuate the trembler, these coils being in series with the main coil.

986,034. SAFETY FUSE AND LINE DISCONNECTING SWITCH; S. B. Way and J. L. Fay, St. Louis, Mo. App. filed April 12, 1909. An insulated block in a casing with lateral stud secured to the base beyond the contacts and an insulated body pivoted and removably mounted on the stud, carrying resilient contacts for receiving the fuse.

986,037. ELECTRIC WATER-HEATER; A. Albert, San Francisco, Cal. App. filed May 21, 1910. An insulated handle with passages for the supply wires, a perforated electrode secured thereto and an inner electrode leaving a water-circulating passageway between the electrodes.

986,039. SYNCHRONIZING INTERRUPTER FOR ELECTRIC CURRENTS; E. Bachelet, New York, N. Y. App. filed Feb. 4, 1909. For wireless telegraphy and for interrupting alternating currents by means of a double throw switch, with one series of contacts for alternating current, another series for direct current, an interrupter in the main circuit in series therewith when direct current is employed, and in shunt therewith when alternating current is employed.

986,064. ELECTRIC BATTERY; C. Jaeger, Seattle, Wash. App. filed July 13, 1910. Provision is made for introducing fluid to moisten the dry cell by means of a liquid holder of telescoping sections, one having a destructible portion and the other having an opening opposite thereto.

986,091. SYSTEM OF MOTOR CONTROL; W. Siebenmorgen and S. H. Keefer, Plainfield, N. J. App. filed Feb. 8, 1910. A motor with a field which is automatically weakened when the current is supplied for starting and restored to normal strength at speed.

986,138. INCANDESCENT LAMP SOCKET; L. J. Castonguay, Bridgeport, Conn. App. filed Jan. 21, 1910. A key socket with a switch block and spindle, an insulating body, a key handle having a lost motion connection with the switch block spindle.

986,179. ELECTRIC FURNACE; C. A. Keller, Paris, France. App. filed Feb. 26, 1904. A plurality of hearths connected by channels with a plurality of electrodes, one for each hearth vertically movable and supplied from the same source of energy.

986,194. WATER-STERILIZING APPARATUS; C. D. Meeker, East Orange, N. J., and C. F. Wallace, New York, N. Y. App. filed Aug. 4, 1910. Sterilizes water by means of ozone, has a tank containing oil with an ozonizing element submerged in the oil, a transformer in the oil connected to the ozonizer.

986,203. POWER ARRESTER; J. W. Novak, Pittsburg, Pa. App. filed Feb. 21, 1910. Power arrester for overhead trolleys to break the circuit, and to give a signal at the power plant for locating the break. Carries contacts to a signaling circuit and is inserted in the trolley wire at the break.

986,213. INSULATING CAP; J. C. Phelps, Springfield, Mass. App. filed Sept. 16, 1909. For the end of tubes carrying wires, the cap having angular outlets through which the wires extend.

986,216. LIFTING MAGNET; H. Poth, Wilkinsburg, Pa. App. filed April 8, 1910. The lifting stroke of the armature is subdivided into a plurality of air gaps which are successively traversed and closed by the magnetic flux during the lifting period, each succeeding gap being reduced to a size to form the path of least resistance for the flux after the preceding gap is closed.

986,243. ALTERNATING-CURRENT ELEVATOR SYSTEM; A. Sundh, Yonkers, N. Y. App. filed Oct. 2, 1907. A motor with a sectional starting resistance, a manual switch, a plurality of fixed and movable contacts in the circuits of relay magnets which are operated successively upon operation of the switch, the switch being automatically retarded.

986,260. SELECTIVE LOCKOUT TELEPHONE SYSTEM; F. W. Adsit, St. Paul, Minn. App. filed Nov. 17, 1909. The party selector with magneto, impulses being sent from the magneto at the calling station to the distant selectors, the selectors at the stations being connected to the transmission lines by one of the distant telephones with means for automatically reversing the current in the line when calling telephone is restored to calling condition.

986,267. TELEPHONE SIGNAL; C. L. Chisholm, Marysville, New Brunswick, Canada. App. filed Sept. 7, 1909. The mouthpiece is used as a call, the hammer actuated by an electro-magnet striking it.

986,277. MOTOR CONTROL SYSTEM; E. L. Gale, Sr., Yonkers, N. Y. App. filed June 20, 1910. Particularly for starting under load by means of a sectional starting resistance, parts of high and low temperature coefficients, which are cut out gradually as the motor increases in speed, this action being accelerated upon increase of drop in the high coefficient resistances.

986,279. AUTOMATIC FIRE ALARM; J. W. Griffith, Greenfield, Tenn. App. filed March 28, 1910. A normally open electric circuit with a spring actuated circuit closing rod having one end in engagement with one of the conducting wires, a casing containing an explosive, a keeper within the casing and engaged by the circuit closing rod to hold it inoperative.

986,291. CONSTRUCTION OF COILS FOR ELECTRICAL APPARATUS; Gottlieb Honold, Stuttgart, Germany. App. filed Dec. 3, 1910. A plurality of groups of coils consisting of layers of insulated wires with an insulating trough inclosing each group and extending on the sides so as to inclose superjacent coils, increasing protection against edge discharge.

986,303. ELECTROPLATING MACHINE; C. C. Miller, Chicago, Ill. App. filed Nov. 23, 1908. The work is carried through the bath by a chain, which carries cathodes from which the articles depend, the articles being carried through the bath between anodes arranged in the bath.

986,304. VACUUM-TUBE LAMP; D. McFarlan Moore, Newark, N. J. App. filed November 26, 1904. An internal electrode vacuum tube containing a gas-evolving organic substance with a heat-conserving envelope.

986,355. AUTOMATIC FIRE ALARM; J. H. Bruhn, Jr., Spirit Lake, Iowa. App. filed Oct. 4, 1910. A telephone circuit with service battery and relay inoperative under the influence of the battery, a signal circuit controlled by the relay, a subscribers' station, an auxiliary battery and a two-point thermostat in the telephone circuit with its points connected to the subscribers' station and the auxiliary battery.

986,382. THERMAL CIRCUIT CLOSER; F. C. Guptill, Elgin, Ill. App. filed May 22, 1909. An expansible two-part bi-metal thermostatic member rigidly attached to a base at one end and having spring contacts at the other moving adjusted terminals, which latter are mounted upon a pivoted lever which forms a pointer which can be set over a gage.